Errata

Title & Document Type: **5382A Frequency Counter Operating and Service Manual**

Manual Part Number: **05382-90001**

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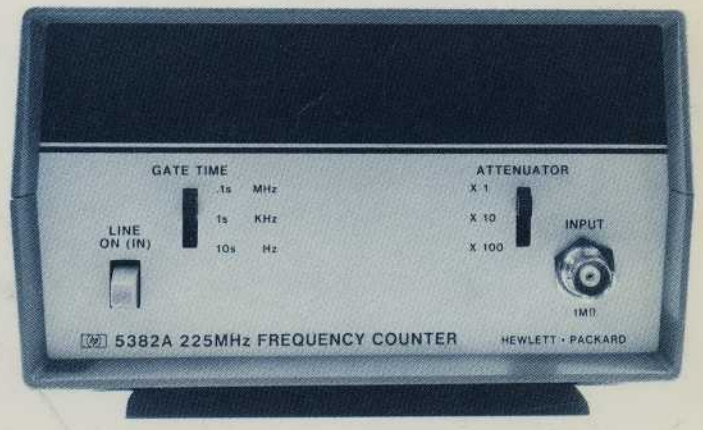
OPERATING AND SERVICE MANUAL

FREQUENCY COUNTER

5382A



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HP 5382A

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FREQUENCY COUNTER

5382A

OPERATING AND SERVICE MANUAL

SERIAL PREFIX: 1408A

This manual applies directly to HP Model 5382A Frequency Counters having serial number prefix 1408A.

NEWER INSTRUMENTS

This manual, with enclosed "Manual Changes" sheet, applies to HP Model 5382A Frequency Counters having serial number prefixes as listed on the "Manual Changes" sheet.

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SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This section of the manual gives a description of the instrument, information on instrument identification and available options, and complete specifications.

1-3. INSTRUMENT DESCRIPTION

1-4. The HP Model 5382A Frequency Counter (see Figure 1-1) is a direct-counting frequency counter that has a range of 10 Hz to 225 MHz. Eight display digits are provided. Front-panel controls allow a selection of gate times and attenuation factors of the input signal. A rear-panel connector and associated selector switch allow connection of an external time base oscillator. This feature also allows ratio measurements to be made by the counter. When the optional temperature compensated crystal oscillator is included (Option 001), the switch is not provided and the connector allows external use of the 10 MHz time base oscillator. Refer to Table 1-1 for all counter specifications.

1-5. INSTRUMENT IDENTIFICATION

1-6. Hewlett-Packard uses a 2-section, 10-character serial number (0000A00000) mounted on the rear panel to identify the instrument. The first four digits are the serial prefix and the last five digits refer to the specific instrument. The alphabetical character identifies the country of manufacture. If the serial prefix on your instrument differs from that listed on the title page of this manual, there are differences between the manual and your instrument. Any lower serial prefixes are documented separately in this manual, and higher serial prefixes are covered by a manual change sheet included with the manual.

1-7. The printed circuit boards within the instrument are identified by a 2-section, 10-digit part number (e.g., 05382-60001) and a 4-digit series number (e.g., "SERIES 1404"). The series number identifies the electrical characteristics of the complete printed-circuit assembly. A replacement circuit-board assembly may have a different series number than the assembly originally supplied with the instrument. Therefore, when troubleshooting a circuit-board assembly, ensure that the series number on the schematic diagram matches the series number on the board assembly. If the series number on the assembly is lower than the number on the schematic diagram in Section III, refer to backdating information in this manual for change information. If the series number on the assembly is higher than the number on the schematic diagram, the change information is provided in a manual change sheet which is available from the nearest Hewlett-Packard Sales and Service Office.

Figure 1-1. Model 5382A Frequency Counter

1-8. SPECIFICATIONS

1-9. Table 1-1 lists all specifications of the frequency counter.

Table 1-1. Specifications

Frequency Range: 10 Hz to 225 MHz

Display: 8 Digit (LEDs)

Input Impedance: 1 MΩ, <40 pf

Sensitivity: 25 mV (rms sinewave) 30 Hz to 10 MHz
50 mV (rms sinewave) 10 Hz to 225 MHz

Input Attenuator: Three Position (x1, x10, x100)

Maximum Input Levels:

ATTENUATOR "x1"	DC to 40 Hz	200 V (dc + Peak ac)
	40 Hz to 100 kHz	250 V rms
	100 kHz to 5 MHz	2.5×10^7 V Hz
	>5 MHz	5 V rms
ATTENUATOR "x10" "x100"	DC to 40 Hz	200 V (dc + Peak ac)
	40 Hz to 1 MHz	250 V rms
	1 MHz to 50 MHz	2.5×10^8 V Hz
	50 MHz to 225 MHz	5 V rms

Accuracy: ±1 Count ± Time Base Accuracy

Gate Times: Manually Selected .1 second, 1 second, 10 seconds

Resolution: 10 Hz at 0.1 second gate time
1 Hz at 1 second gate time
0.1 Hz at 10 second gate time

Time Base: Internal
Frequency: 10 MHz Crystal
Aging: <0.3 ppm/Month
Temperature: ±2.5 ppm 0°C to 40°C
Line Voltage: ±0.5 ppm for 10% line variation

External Input
Frequency Range: 100 kHz to 10 MHz
Sensitivity: 250 mV rms
1 KΩ input impedance
Maximum Input: 25 V rms dc to 10 MHz

Operating Temperature: 0°C to 40°C

Power Requirements: 100, 120, 220, and 240 V rms (48 Hz to 440 Hz) (+5%—15%) 20 VA max.

Weight: Net: 4.75 lb (2,2 kg) Shipping: 6 lb (2,8 kg)

Dimensions: 3.5 in. H x 6.25 in. W x 9.75 in. D (89 mm x 160 mm x 248 mm)

OPTION 001

Temperature Compensated Crystal Oscillator Frequency: 10 MHz
Aging: <1 part in 10^7/Month
Temperature: ±1 ppm 0°C to 40°C
Line Voltage: 1 part in 10^7 for 10% change
External input replaced with Oscillator Monitor Output on Option 001

SECTION II

INSTALLATION AND OPERATION

2-1. INTRODUCTION

2-2. This section of the manual provides information about unpacking, inspecting, storing, and shipping the frequency counter and gives instructions for operating the counter. Descriptions of all controls, connectors, and indicators are included.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage such as scratches, dents, broken switches, etc. If the instrument is damaged or fails to meet performance tests, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately. Performance check procedures are located in Section III, and Sales and Service Offices are listed at the back of this manual. Retain the shipping carton and the padding material for the carrier's inspection. The Sales and Service Office will arrange for the repair or replacement of the instrument without waiting for the claim against the carrier to be settled.

2-5. STORAGE AND SHIPMENT

2-6. PACKAGING. To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Your Hewlett-Packard Sales and Service Office can provide packaging material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice.

2-7. ENVIRONMENT. Conditions during storage and shipment should normally be limited as follows:

a. Maximum altitude: 25,000 ft.
b. Minimum temperature: -40°F (-40°C).
c. Maximum temperature: +131°F (+55°C).

2-8. LINE VOLTAGE SELECTION

2-9. The counter is supplied from the factory with the LINE VOLTAGE SELECTOR switches set for 120-volt, 60 Hz operation. If any other supply voltage is to be used, change the rear-panel switch settings as follows:

a. Using a small screwdriver, a pencil, or other suitable tool, set the LINE VOLTAGE SELECTOR switches on the counter's rear panel to the positions shown next to the desired voltage marking on the rear panel.

b. Ensure that the correct fuse is installed. Use a Listed, 0.250 ampere, slow-blow fuse for 100-volt or 120-volt operation or a Listed, 0.125 ampere, slow-blow fuse for 220-volt or 240-volt operation.

2-10. If the counter is to be used in the USA with a 240-volt, 60 Hz power source, use a power cord with a Listed connector of the type shown in Figure 2-1.

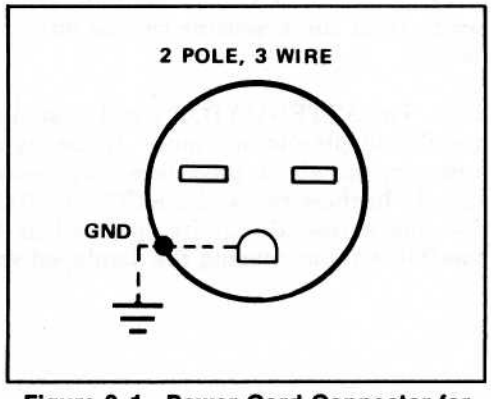


Figure 2-1. Power Cord Connector for 240-Volt Operation

2-11. OPERATION

2-12. Figures 2-2 and 2-3 describe the operation of each panel control, connector, and indicator. The following paragraphs describe proper cable and cable termination use, how to make ratio measurements with the counter, and how to optimize noise rejection with the ATTENUATOR.

2-13. Cable and Termination Requirements

2-14. To prevent miscounting due to noise, shielded cables should be used to make measurements. More specifically, a coaxial cable with a 50-ohm characteristic impedance and BNC connectors at each end are recommended for most measurements. At higher frequencies the 50-ohm cable becomes an important factor. Whenever the measured source has a 50-ohm output impedance (this is the case with most test oscillators), a 50-ohm feedthrough termination should be used. On the other hand, in cases where minimal source loading is desirable, the 50-ohm feedthrough termination should be omitted from the circuit. At frequencies up to approximately 10 MHz, and at all but the lowest signal levels, a 10:1 divider probe can be used to further reduce source loading.

2-15. Ratio Measurements (Standard Counter Only)

2-16. The standard counter will measure the ratio between the frequencies of two signals if one of the signals is applied to the rear-panel OSCILLATOR-EXT IN connector and the other signal is applied to the front-panel INPUT connector. (The Option 001 counter does not have an external oscillator input connector.) Be sure to refer to Table 1-1 for signal level and frequency limits. The displayed value represents the ratio of one frequency to the other as shown by the following formula:

$$\frac{\text{freq at INPUT}}{\text{freq at OSCILLATOR-EXT IN}} = \frac{\text{Display Value}}{X}$$

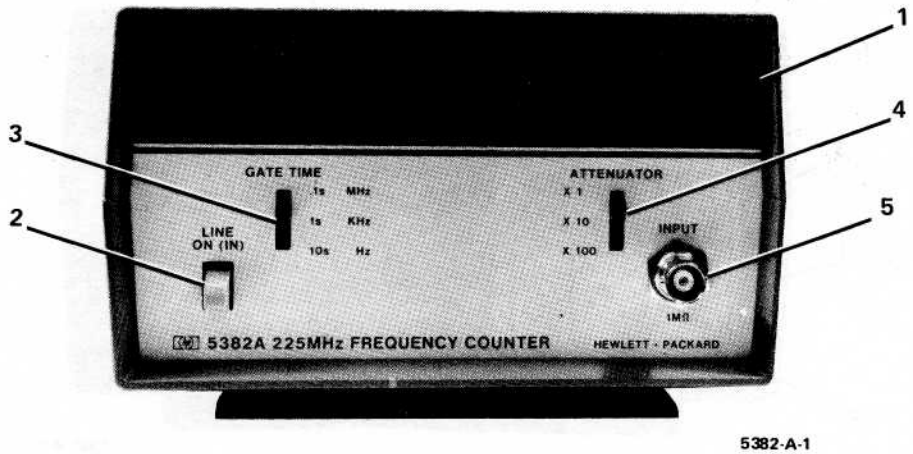
where X = 10 if GATE TIME is .1s
10^4 if GATE TIME is 1s
10^7 if GATE TIME is 10s

2-17. Note that in the above formula the term "X" changes by a factor of 1000 (10^3) for each change in GATE TIME setting. GATE TIME, itself, changes "X" by a factor of 10, and the decimal point in the display shifts two places (10^2) for a total of 10^3. Note, also, that actual measurement time increases as the frequency applied to the OSCILLATOR-EXT IN connector decreases. If the frequency applied to the OSCILLATOR-EXT IN connector is 1 MHz, for example, and GATE TIME is set to 1s, actual measurement time will be 10 seconds.

2-18. Optimizing Noise Rejection

2-19. A measured signal may have a large harmonic content or noise from other sources. The presence of either can cause inaccurate or unstable displays from the counter. Measurement errors from these sources can be minimized or eliminated by proper use of the ATTENUATOR switch.

2-20. The ATTENUATOR should usually be set to "X100", then reduced, one step at a time, until a stable display is obtained. If the signal contains a high percentage of amplitude modulation, however, the above procedure may cause counting of only a portion of the cycles of the carrier signal. In these cases, the ATTENUATOR should be set to "X1" (be sure that the input amplitude does not exceed the limits specified in Table 1-1), then increased to "X10" or "X100" if this is possible without causing the displayed value to change or become unstable.



5382-A-1

1. Display: Eight digits of LED (light-emitting diode) display are provided on the front panel. A decimal point illuminates in the proper position according to the setting of the GATE TIME switch, and an over-range indicator in the upper, left corner of the display illuminates when the counter overflows.

2. LINE switch: The ac power LINE switch is a push-on, push-off type; in the on position, the pushbutton is set further into the front panel.

3. GATE TIME switch: Gate time (measurement time) can be set at 0.1-second, 1-second, or 10 seconds with the GATE TIME switch. These positions give resolutions of 10 Hz, 1 Hz, and 0.1 Hz, respectively. If the GATE TIME switch is set to 1s, for example, it will take one second to make a measurement and the measured value will be displayed in 1 Hz increments. Manual resetting of the counter circuits occurs whenever the GATE TIME switch position is changed. Set the GATE TIME switch to provide the best compromise between measurement speed and resolution of the displayed value.

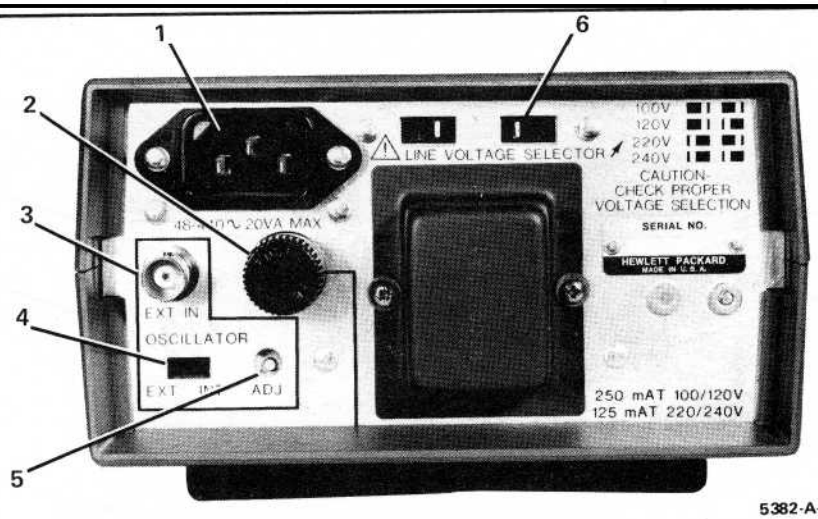
4. ATTENUATOR switch: The three-position attenuator switch provides for attenuation of input signals by factors of 10 and 100. The input signal is not attenuated when the switch is set to the "X1" position. The attenuator is used to extend the range of input signal levels that can be measured by the counter and to optimize noise rejection. Maximum sensitivity of the counter ranges from 25 millivolts rms with the attenuator set to "X1" to 2.5 volts rms with the attenuator set to "X100". If the amplitude of a measured signal is unknown or if signal noise causes the display to be unstable, set the ATTENUATOR to "X10" or "X100", then reduce the attenuation, if necessary, until a stable display is observed.

CAUTION

BE SURE THAT THE MAXIMUM ALLOWABLE INPUT VOLTAGES AS GIVEN IN TABLE 1-1, SPECIFICATIONS, ARE NOT EXCEEDED. DAMAGE TO THE COUNTER MAY OTHERWISE RESULT.

5. INPUT connector: Connect the signal to be measured to the BNC-type INPUT jack. Input impedance is 1.0 megohm.

Figure 2-2. Front Panel Operating Controls, Connectors, and Indicators



5382-A-2

1. Power connector: Connect the source of ac power to the rear-panel power connector.

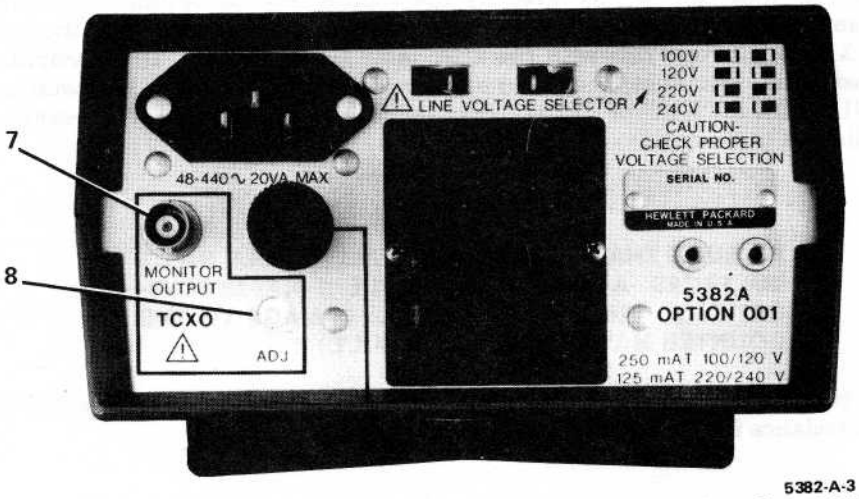
2. Fuse: A Listed, 0.250 ampere, slow-blow fuse is required for 100-volt or 120-volt operation; a Listed, 0.125 ampere, slow-blow fuse is required for 220-volt or 240-volt operation.

3. OSCILLATOR-EXT IN connector: An external oscillator can be used in place of the counter's internal time base oscillator. Connect the signal to the OSCILLATOR-EXT IN connector and set the OSCILLATOR-EXT/INT switch to EXT. See Table 1-1 for oscillator signal requirements.

4. OSCILLATOR-EXT/INT switch: Set the EXT/INT switch to correspond with the source of the time base oscillator signal (see item 3, above).

5. OSCILLATOR-ADJ control: The ADJ control is used to set the frequency of the internal time base oscillator. Refer to the *Adjustments* paragraphs in Section III for information.

6. LINE VOLTAGE SELECTOR switches: Set the switches to correspond with the voltage of the ac power source. (Refer to Paragraph 2-8 for instructions.)



5382-A-3

7. MONITOR OUTPUT connector: Use this connector to monitor the 10 MHz time base oscillator.

8. ADJ control: Same as 5, above.

Figure 2-3. Rear-Panel Operating Controls and Connectors

SECTION III

MAINTENANCE

3-1. INTRODUCTION

3-2. This section of the manual provides all information necessary to service the counter. The following topics are included:

a. Theory of circuit operation.

b. In-cabinet performance checks.

c. Instrument access instructions.

d. Preventive maintenance.

e. General repair information.

f. Adjustment procedures.

g. Troubleshooting instructions.

h. Replaceable parts lists.

i. A schematic diagram with support information.

3-3. THEORY OF CIRCUIT OPERATION

3-4. The input limiter, the input amplifier, and the Schmitt trigger circuits (see the block diagram of Figure 3-1) condition the measured input signals and ensure that subsequent digital circuits receive pulses with uniform rise and fall times. When the time base circuits open the main gate, these pulses pass through the main gate and are accumulated in the decade counter circuits. After the gate time elapses and the main gate closes, the counted data is stored in the data latches. The multiplexer circuits supply this stored data, one digit at a time, to the LED display. The display scan circuits synchronize the multiplexer circuits with the display enable lines, and this ensures that the proper BCD data digit is placed on the multiplexed data lines when the associated LED display digit is enabled.

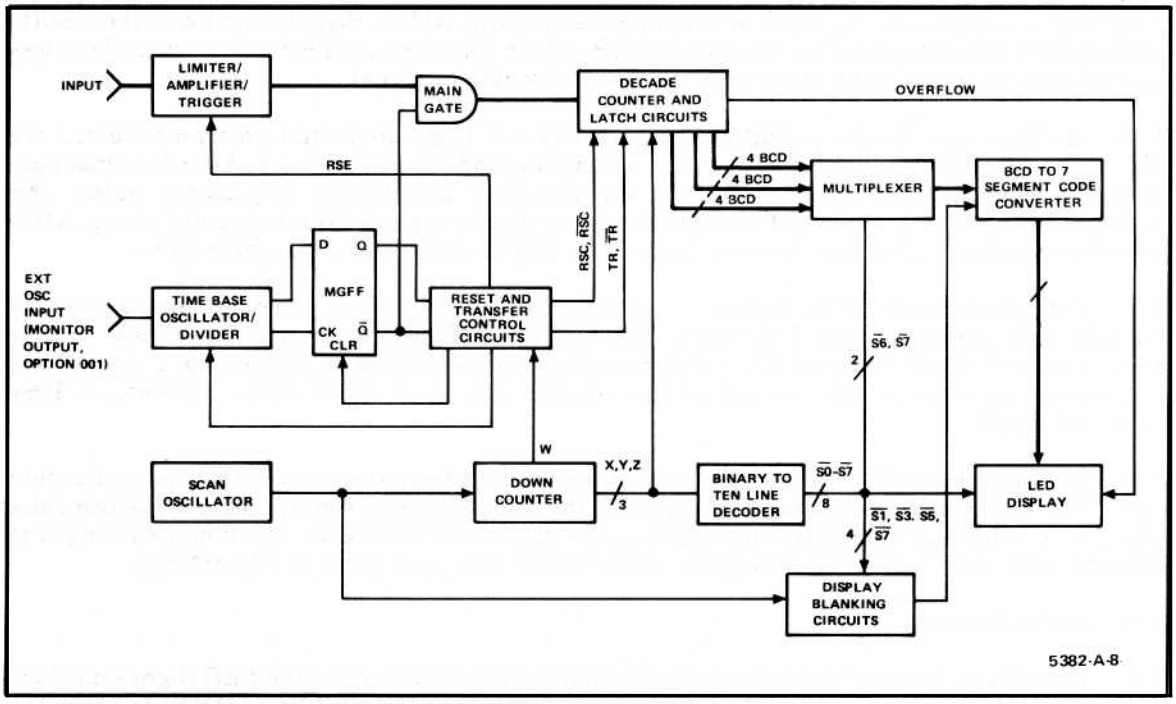


Figure 3-1. Simplified Block Diagram

3-5. Input Circuits

3-6. Input signals pass first through the attenuator. Diodes A1CR9 and A1CR10 limit the input signal amplitude to a safe level for the subsequent circuits. Resistors A1R46 and A1R48 limit the current drawn by the diodes from high-voltage sources and, thus, reduce loading of these sources. Transistors A1Q13, A1Q14, and A1Q15 form a unity gain buffer amplifier that has a high input impedance, which reduces source loading, and a low output impedance to drive amplifier A1U16B. Amplifier A1U16B provides an approximate voltage gain of five and is direct coupled to A1U16C which functions as a Schmitt trigger. The balance adjustment, A1R42, provides control of the dc bias voltage applied to A1U16B to allow sensitivity to be optimized. The Schmitt trigger output passes through amplifier A1U16D and then through the main gate/level translator, A1Q9, A1Q10, A1Q11. The main gate flip-flop, A1U5A, controls the conduction of transistor A1Q11 which, in turn, controls the passage of input pulses through the level translator, A1Q9 and A1Q10.

3-7. Decade Counter, Latch, and Multiplexer Circuits

3-8. After the measured input signal passes through the main gate/level translator (A1Q9, A1Q10, and A1Q11) it is accumulated in the decade counter circuits. Counter A1U11 counts the least-significant decimal digit, counter A1U15 counts the next-significant digit, and counter A1U14 counts the six, most-significant digits. After the main gate closes, the TR (Transfer) and $\overline{TR}$ signals transfer the accumulated data from the counter circuits into storage latches A1U9, A1U20, and the latches that are part of A1U14 (refer to timing diagram of Figure 3-4). The stored data is then supplied to the display, one 4-bit BCD digit at a time, as controlled by the X, Y, Z, S6, and $\overline{S7}$ signal lines from the display scanner. Circuits within A1U14 control the multiplexing operation for the six, most-significant digits; the X, Y, and Z lines provide the address code. Separate gates within integrated circuits A1U8 and A1U14 gate the two, least-significant digits onto the data lines in response to the $\overline{S6}$ and $\overline{S7}$ signals. (When the $\overline{S6}$ or $\overline{S7}$ signal line is low, the X, Y, and Z lines provide a binary 110 or 111 to A1U14. Either of these codes causes all data output lines from A1U14 to go high, which allows the outputs of the two, least-significant decade counters to control the data lines.)

3-9. Time Base Oscillator and Divider

3-10. The time base oscillator consists of integrated circuit A1U1C and associated components. The 10 MHz oscillator signal passes through amplifier A1U1A and level translator A1Q1 and A1Q2 and is supplied to the input of the time base divider, A1U4. Signals applied to the OSCILLATOR EXT IN jack pass first through A1U1B, which functions as a Schmitt trigger, then pass through A1U1A in the same manner as the internal oscillator signal.

3-11. The time base divider provides Time Base Out and Log signals that are used to control the main gate flip-flop, A1U5A. (Refer to the timing diagram of Figure 3-4.) After the time base divider resets, the first input pulse from the oscillator generates a Log output pulse. An additional Log pulse is generated as each successive divider stage within integrated circuit A1U4 provides an output. (The time between Log pulses, therefore, increases logarithmically.)

3-12. Integrated circuit A1U4 divides the 10 MHz oscillator signal by a factor determined by the three-bit code present at pins 7, 8, and 9. The GATE TIME switch changes this code to provide division factors of 10^6, 10^7, and 10^8, which correspond to gate times of 0.1 second, 1 second, and 10 seconds, respectively. At the end of the selected gate time, circuit A1U4 generates a Time Base Out signal.

3-13. The Main Gate flip-flop, A1U5A, sets when the first Log pulse occurs; this opens the main gate. The Main Gate flip-flop remains set until the Time Base Out signal goes low; the Log pulse that occurs when the Time Base Out signal is low clocks the Main Gate flip-flop, returning it to the reset state and closing the main gate. (Refer to the timing diagram of Figure 3-4.)

3-14. Display Scanner

3-15. The display scanner consists of all the circuits necessary to drive the LED (light-emitting-diode) displays. An oscillator with a frequency of approximately 8 kHz (A1U3B) supplies the

input to a four-bit down-counter (A1U12). The four outputs of the counter supply a continuously cycling binary code that is used both for display scanning and counter timing.

3-16. Integrated circuit A1U17 decodes the three most significant outputs (the X, Y, and Z lines) from the four-bit counter and supplies outputs on eight separate lines, one drive line for each of the eight display digits. The X, Y, and Z lines also are used as the address lines to A1U14, where they control the multiplexing of data. This synchronizes the data output with the sequential enabling of the display digits. Integrated circuit A2U1 converts the four data bits from BCD to the seven-segment code required to drive the display. Data is supplied from circuit A2U1 to all eight display positions simultaneously, and the $\overline{S0}$ through $\overline{S7}$ lines enable only the single display position that corresponds to the data on the data lines at a given time. Transistors A2Q1 through A2Q8 provide sufficient current to drive the LED displays.

3-17. Display Blanking Circuits

3-18. Leading zeros in the display, except the first digit to the left of the decimal point, are automatically blanked by the display blanking circuits. Trailing zeros are not blanked. Blanking occurs only when a BCD "zero" is on the multiplexed data lines and the RBI signal to A2U1 is low. When these conditions are fulfilled, the display digit being strobed is blanked and the RBO signal from A2U1 goes low.

3-19. At the beginning of each display scan cycle, the $\overline{S5}$ signal goes low, which causes the RBI signal (the output of A1U3A) to go low. Therefore, if the most-significant display digit (which is strobed by the $\overline{S5}$ signal) is a zero, the zero will be blanked. As the scan cycle progresses ($\overline{S4}$ goes low, $\overline{S3}$ goes low, etc.), each less-significant display digit is blanked until one of the following conditions occurs: 1) the $\overline{OF}$ signal goes low indicating a counter overflow, 2) the data on the multiplexed data lines changes to a number other than zero, or 3) the scan cycle progresses to the digit immediately to the left of the decimal point. In any of these circumstances, the RBO signal will go high, and the high level will be stored in the Blanking Storage latch, A1U6B. The high Q output of the Blanking Storage latch forces the RBI signal to go high, which prevents further blanking until the start of the next scan cycle (when $\overline{S5}$ goes low).

3-20. Reset and Transfer Control Circuits

3-21. The reset and transfer control circuits control the sequencing of the counter. (Refer to the timing diagram of Figure 3-4.) When the main gate closes at the end of a measurement and the Z signal line from the display scanner subsequently goes low, the Reset Enable latch (A1U6A) sets. The high Q output (pin 5) holds the time base divider IC (A1U4) in a reset condition, and the low $\overline{Q}$ output (pin 6) allows the W signal to control the output of gate A1U2A (when the $\overline{Q}$ output is high, the output of A1U2A is always high.) The W, $\overline{S1}$, $\overline{S2}$, and $\overline{S7}$ signals cause the following sequence of events to occur. (Because the $\overline{S1}$, $\overline{S2}$, and $\overline{S7}$ signals are gated with W the signal, the described events occur during the middle of the $\overline{S1}$, $\overline{S2}$, and $\overline{S7}$ signals which ensures that these signal lines are stable.) First, when the $\overline{S2}$ and W signals are low, the TR and $\overline{TR}$ signals are generated and used to transfer data from the decade counters to the storage latches. When the $\overline{S1}$ and W signals are low, the RSC and $\overline{RSC}$ signals are generated and used to reset the decade counters. The RSC signal also passes through level translator A1Q8, emerging as the RSE signal, which is applied to amplifier A1U16A. The output of A1U16A presets the Schmitt trigger in the input circuit between each measurement. When the $\overline{S7}$ and W signals are low, the Reset Enable latch resets and a new measurement cycle begins.

3-22. RECOMMENDED TEST EQUIPMENT

3-23. Test equipment recommended for maintaining the counter is listed in Table 3-1. Equipment with equivalent characteristics may be substituted for the recommended equipment.

Table 3-1. Recommended Test Equipment

Instrument Type	Required Characteristics	Recommended Instrument
Electronic Counter	10 MHz frequency measurements and high stability time base.	HP 5326C-011
VHF Oscillator	Range: 225 MHz	HP 3200B
Test Oscillator	Range: 10 Hz to 10 MHz. Output: 2.5 Vrms.	HP 651B
RF Millivoltmeter	Frequency: 20 MHz to 225 MHz. Range: 25 mV rms to 50 mV rms.	HP 411A or HP 3406A
50-Ohm Feed-Thru	50-Ohm termination, male-to-female BNC connectors.	HP 11048A
Logic Probe	Logic level measurements.	HP 10525T
Oscilloscope	10 MHz measurements.	HP 180A/1801A/1820A

3-24. IN-CABINET PERFORMANCE CHECK

3-25. Use the performance check in Table 3-2 to verify proper operation of all circuits within the counter. The check should be used when improper operation or nonconformance to specifications is suspected.

3-26. INSTRUMENT ACCESS

3-27. Most maintenance operations require that the top and bottom covers be removed from the counter. Remove the covers according to the following procedure.

WARNING

DISCONNECT THE AC POWER CORD FROM THE COUNTER PRIOR TO REMOVING COVERS. EXPOSED TERMINALS WITHIN THE COUNTER (INCLUDING SEVERAL POINTS ON THE PRINTED-CIRCUIT BOARDS) CAN SUPPLY SUFFICIENT ENERGY TO CAUSE INJURY OR DEATH.

a. Position the instrument upside down and remove the four machine screws from the bottom of the instrument.

b. Lift the bottom cover from the instrument, then remove the printed circuit boards (with the front and rear panels attached) by pulling the boards straight out of the top cover.

c. Reassemble in reverse order of disassembly; ensure that the standoff spacers on top cover are aligned with the corresponding holes on the main circuit board.

Table 3-2. In-Cabinet Performance Check

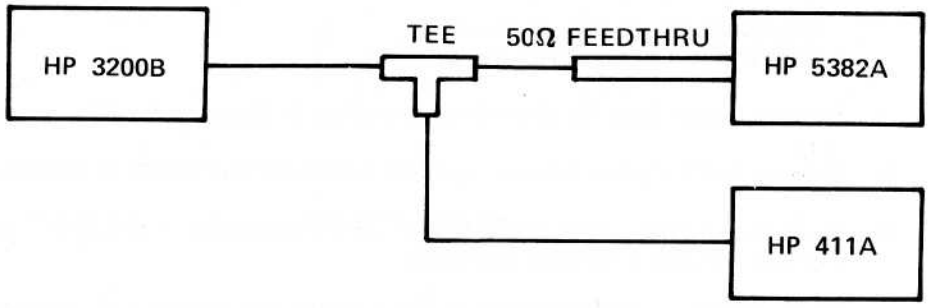
1. SENSITIVITY

Obtain the following test equipment:

HP 411A RF Millivoltmeter
HP 651B Test Oscillator
HP 3200B UHF Oscillator
HP 11048A 50-Ohm Feed-Thru

a. Set the counter's ATTENUATOR switch to X1.

b. Connect the test equipment to the counter as shown below.



c. Set the 3200B to provide a 225 MHz output at 50 mV rms as indicated on the 411A.

d. Counter's display should indicate 225 MHz and displayed value should be stable.

e. Set the 3200B to provide a 10 MHz output at 25 mV rms as indicated on the 411A.

f. Counter's display should indicate 10 MHz and displayed value should be stable.

g. Remove 3200B and 411A, and connect the 50Ω output of the 651B to the counter. Use a 50-ohm feed-thru at the counter's INPUT connector.

h. Set the 651B to provide an output of 10 Hz at 50 mV rms.

i. Counter's display should indicate 10 Hz and displayed value should be stable.

j. Set the 651B to provide an output of 30 Hz at 25 mV rms.

k. Counter's display should indicate 30 Hz and displayed value should be stable.

2. EXTERNAL OSCILLATOR INPUT (STANDARD UNIT ONLY)

Obtain the following test equipment:

HP 651B Test Oscillator
HP 11048A 50-Ohm Feed-Thru

a. Set the counter's ATTENUATOR switch to X1, GATE TIME switch to .1s, and OSCILLATOR-EXT/INT switch to EXT.

b. Connect the 50Ω output of the 651B to the counter's rear-panel OSCILLATOR-EXT IN connector through a Tee connector and a 50-ohm feed-thru termination.

Table 3-2. In-Cabinet Performance Check (Continued)

c. Connect a cable between the unused end of the Tee connector and the counter's front-panel INPUT connector.

d. Set the 651B for an output of 10 MHz at 250 mV rms. The counter's display should be 010.00000 ±1 count.

e. Set the 651B for an output of 100 kHz at 250 mV rms. The counter's display should be 010.00000 ±1 count.

3. OSCILLATOR OUTPUT (OPTION 001 ONLY)

Obtain the following test equipment:

HP 5326C-011 Electronic Counter
HP 11048A 50-Ohm Feed-Thru

a. Remove covers from the counter as described in Paragraph 3-26.

b. Connect counter to ac power and allow 1-hour for the TCXO to stabilize.

c. Connect the rear-panel MONITOR OUTPUT connector to the 5326C-011 input jack through a 50-ohm feed-thru.

d. Set the 5326C-011 FUNCTION switch to FREQUENCY and the TIME BASE switch to 10S.

e. At 25°C ambient temperature, the 5326C-011 display should be the frequency that is printed on the TCXO (for example, 10 MHz "+4.4 Hz"). If necessary, refer to the adjustment procedures in this section of the manual.

4. DISPLAY

Obtain the following test equipment:

HP 651B Test Oscillator
HP 11048A 50-Ohm Feed-Thru

a. With no signal applied, set the front-panel GATE TIME switch to each of its three settings. The decimal point should move to give the following displays:

000.00000 for .1s gate time,
00000.000 for 1s gate time,
0000000.0 for 10s gate time,

b. Connect the 651B to the counter's INPUT connector. Use the 50-ohm feed-through at the counter-end of the cable.

c. Adjust the 651B frequency and the counter GATE TIME switch until an eight has been observed in each of the eight display positions. This ensures that each display segment is operative.

3-28. PREVENTIVE MAINTENANCE

3-29. Periodically, perform the In-Cabinet Performance Check of Table 3-2 to verify proper operation of the counter. Additionally, whenever the covers are removed, check for broken or burned components, damaged wires, excess dust, etc.

3-30. GENERAL REPAIR

3-31. The following paragraphs provide general repair information for the counter.

3-32. COMPONENT REPLACEMENT. When replacing a circuit board component, use a low heat soldering iron. Heat must be used sparingly as damage to the circuit foil may otherwise occur. Mounting holes may be cleaned with a toothpick while heat is applied. After component removal and replacement, clean connections with a suitable cleaning solution.

3-33. INTEGRATED CIRCUIT REPLACEMENT. Two methods are recommended for removing integrated circuits:

a. Solder Gobbler. Solder is removed from board by a soldering iron with a hollow tip that is connected to a vacuum source. The IC is removed intact, so it may be reinstalled if it is later proven not to be defective.

b. Clip Out. This method is used when an IC is proven defective. Clip leads close to case, apply heat, and remove leads with long-nose pliers. Clean board holes with a toothpick and cleaning solution.

3-34. ADJUSTMENTS

3-35. The counter requires two circuit adjustments: 1) the input amplifier balance adjustment and 2) the time base oscillator adjustment. Perform the adjustments according to the following procedures.

3-36. Amplifier Balance Adjustment

3-37. Adjust the input amplifier balance as follows:

a. Remove top and bottom covers from the counter as described in Paragraph 3-26. Be sure to observe WARNING note in Paragraph 3-26.

b. Connect the oscilloscope to A1U11, pin 5, on the A1 Main Board Assembly.

c. Connect the test oscillator 50Ω output to the front-panel INPUT connector (use a 50-Ohm feed-through at the INPUT connector), and set the test oscillator to provide an output of approximately 30 mV rms at a frequency of 1 MHz.

d. Connect ac power to the counter. Be sure to observe the WARNING note in Paragraph 3-26.

e. Adjust potentiometer A1R42 until the oscilloscope shows that the signal at A1U11, pin 5 has a 50 percent duty cycle.

f. Remove ac power from the counter, remove test equipment, and install the counter in the top and bottom covers.

3-38. Oscillator Adjustment (Standard Unit)

3-39. Set the time base oscillator frequency as follows:

a. Connect ac power to the counter, depress the front-panel LINE switch, and allow 5 minutes for the oscillator to stabilize.

b. Connect the rear-panel oscillator output jack on the 5326C-011 (or equivalent, stable, 10 MHz source) to the counter's INPUT connector.

c. Set the counter's GATE TIME switch to 1s and adjust the rear-panel OSCILLATOR ADJ. control until the counter display indicates exactly 10 MHz. Note that the actual display is in kilohertz (10000.000).

d. Remove ac power and disconnect test equipment.

3-40. Oscillator Adjustment (Option 001 Unit)

3-41. Set the time base oscillator as follows:

a. Remove the top and bottom covers from the counter as described in Paragraph 3-26. Be sure to observe WARNING note in Paragraph 3-26.

b. Connect ac power to the counter and allow 1-hour for the TCXO to stabilize.

c. Connect the rear-panel MONITOR OUTPUT connector to the 5326C-011 input jack.

d. Set the 5326C-011 FUNCTION switch to FREQUENCY and the TIME BASE switch to 10s.

e. At 25°C ambient temperature, adjust the rear-panel oscillator ADJ control until the frequency displayed by the 5326C-011 is the same as the frequency printed on the TCXO (for example, 10 MHz, "+4.4 Hz").

f. Remove ac power from the counter, disconnect test equipment, and install the counter in the top and bottom covers.

3-42. TROUBLESHOOTING

3-43. Malfunctions of the counter circuits produce several symptoms of trouble. The troubleshooting flowchart of Figure 3-2 lists these symptoms and provides a sequential test to isolate the trouble to a component or small group of components. To troubleshoot the counter, find the observed symptom at the top of the flowchart and perform the indicated circuit checks.

3-44. Additional information in the form of a timing diagram, Figure 3-4, and waveform illustrations (with the schematic diagram) is provided to aid troubleshooting.

3-45. REPLACEABLE PARTS

3-46. Table 3-3 lists parts used in the counter in alphanumeric order of their reference designations and provides the following information for each part. Miscellaneous parts are listed at the end of Table 3-3.

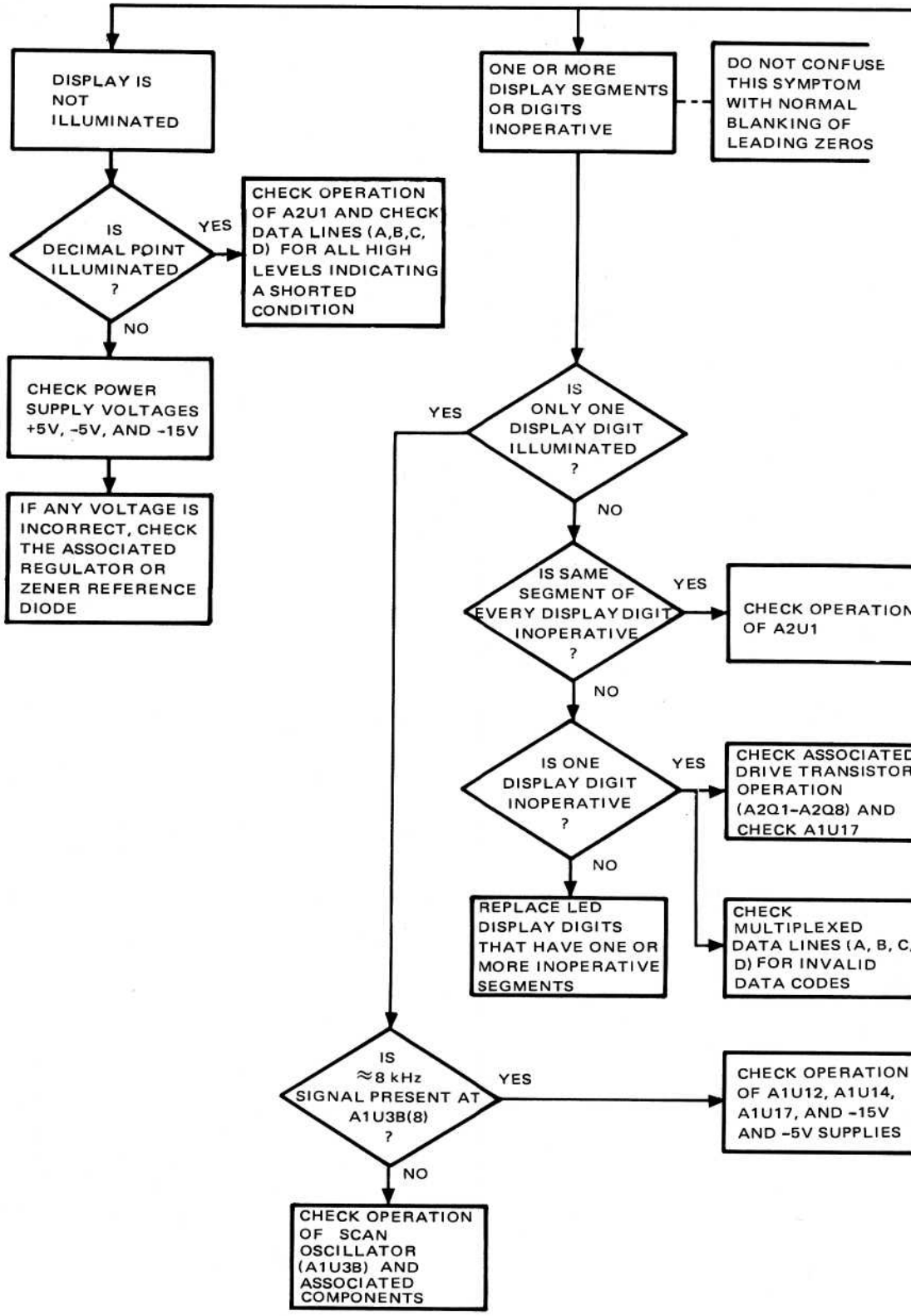
a. Hewlett-Packard part number.

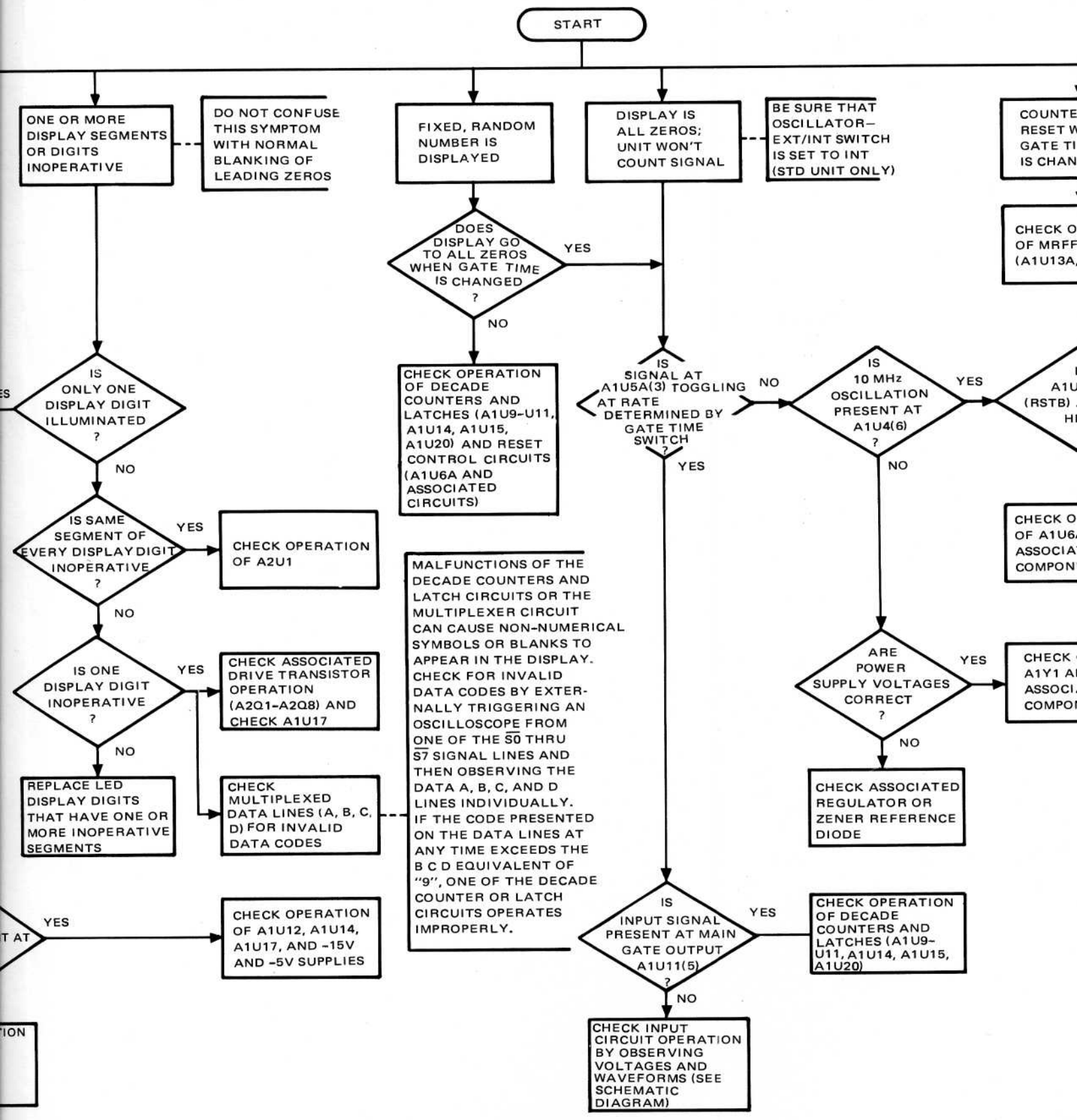
b. Description of part (see abbreviations below).

c. Total quantity used in the instrument (shown only after the first entry for a given part).

d. Typical manufacturer of the part in a five-digit code (see list of manufacturers in Table 3-4).

e. Manufacturer's part number.


DISPLAY IS NOT ILLUMINATED
IS DECIMAL POINT ILLUMINATED ?
YES
CHECK OPERATION OF A2U1 AND CHECK DATA LINES (A,B,C, D) FOR ALL HIGH LEVELS INDICATING A SHORTED CONDITION
NO
CHECK POWER SUPPLY VOLTAGES +5V, -5V, AND -15V
IF ANY VOLTAGE IS INCORRECT, CHECK THE ASSOCIATED REGULATOR OR ZENER REFERENCE DIODE
ONE OR MORE DISPLAY SEGMENTS OR DIGITS INOPERATIVE
DO NOT CONFUSE THIS SYMPTOM WITH NORMAL BLANKING OF LEADING ZEROS
IS ONLY ONE DISPLAY DIGIT ILLUMINATED ?
YES
NO
IS SAME SEGMENT OF EVERY DISPLAY DIGIT INOPERATIVE ?
YES
CHECK OPERATION OF A2U1
NO
IS ONE DISPLAY DIGIT INOPERATIVE ?
YES
CHECK ASSOCIATED DRIVE TRANSISTOR OPERATION (A2Q1-A2Q8) AND CHECK A1U17
NO
REPLACE LED DISPLAY DIGITS THAT HAVE ONE OR MORE INOPERATIVE SEGMENTS
CHECK MULTIPLEXED DATA LINES (A, B, C, D) FOR INVALID DATA CODES
IS ≈8 kHz SIGNAL PRESENT AT A1U3B(8) ?
YES
CHECK OPERATION OF A1U12, A1U14, A1U17, AND -15V AND -5V SUPPLIES
NO
CHECK OPERATION OF SCAN OSCILLATOR (A1U3B) AND ASSOCIATED COMPONENTS


START
ONE OR MORE DISPLAY SEGMENTS OR DIGITS INOPERATIVE
DO NOT CONFUSE THIS SYMPTOM WITH NORMAL BLANKING OF LEADING ZEROS
FIXED, RANDOM NUMBER IS DISPLAYED
DISPLAY IS ALL ZEROS; UNIT WON'T COUNT SIGNAL
BE SURE THAT OSCILLATOR–EXT/INT SWITCH IS SET TO INT (STD UNIT ONLY)
DOES DISPLAY GO TO ALL ZEROS WHEN GATE TIME IS CHANGED ?
YES
NO
IS ONLY ONE DISPLAY DIGIT ILLUMINATED ?
NO
IS SAME SEGMENT OF EVERY DISPLAY DIGIT INOPERATIVE ?
YES
CHECK OPERATION OF A2U1
NO
IS ONE DISPLAY DIGIT INOPERATIVE ?
YES
CHECK ASSOCIATED DRIVE TRANSISTOR OPERATION (A2Q1-A2Q8) AND CHECK A1U17
NO
REPLACE LED DISPLAY DIGITS THAT HAVE ONE OR MORE INOPERATIVE SEGMENTS
CHECK MULTIPLEXED DATA LINES (A, B, C, D) FOR INVALID DATA CODES
CHECK OPERATION OF DECADE COUNTERS AND LATCHES (A1U9-U11, A1U14, A1U15, A1U20) AND RESET CONTROL CIRCUITS (A1U6A AND ASSOCIATED CIRCUITS)
MALFUNCTIONS OF THE DECADE COUNTERS AND LATCH CIRCUITS OR THE MULTIPLEXER CIRCUIT CAN CAUSE NON-NUMERICAL SYMBOLS OR BLANKS TO APPEAR IN THE DISPLAY. CHECK FOR INVALID DATA CODES BY EXTERNALLY TRIGGERING AN OSCILLOSCOPE FROM ONE OF THE $\overline{S0}$ THRU $\overline{S7}$ SIGNAL LINES AND THEN OBSERVING THE DATA A, B, C, AND D LINES INDIVIDUALLY. IF THE CODE PRESENTED ON THE DATA LINES AT ANY TIME EXCEEDS THE B C D EQUIVALENT OF "9", ONE OF THE DECADE COUNTER OR LATCH CIRCUITS OPERATES IMPROPERLY.
IS SIGNAL AT A1U5A(3) TOGGLING AT RATE DETERMINED BY GATE TIME SWITCH ?
NO
YES
IS 10 MHz OSCILLATION PRESENT AT A1U4(6) ?
YES
NO
ARE POWER SUPPLY VOLTAGES CORRECT ?
YES
NO
CHECK ASSOCIATED REGULATOR OR ZENER REFERENCE DIODE
IS INPUT SIGNAL PRESENT AT MAIN GATE OUTPUT A1U11(5) ?
YES
CHECK OPERATION OF DECADE COUNTERS AND LATCHES (A1U9-U11, A1U14, A1U15, A1U20)
NO
CHECK INPUT CIRCUIT OPERATION BY OBSERVING VOLTAGES AND WAVEFORMS (SEE SCHEMATIC DIAGRAM)
CHECK OPERATION OF A1U12, A1U14, A1U17, AND -15V AND -5V SUPPLIES
YES

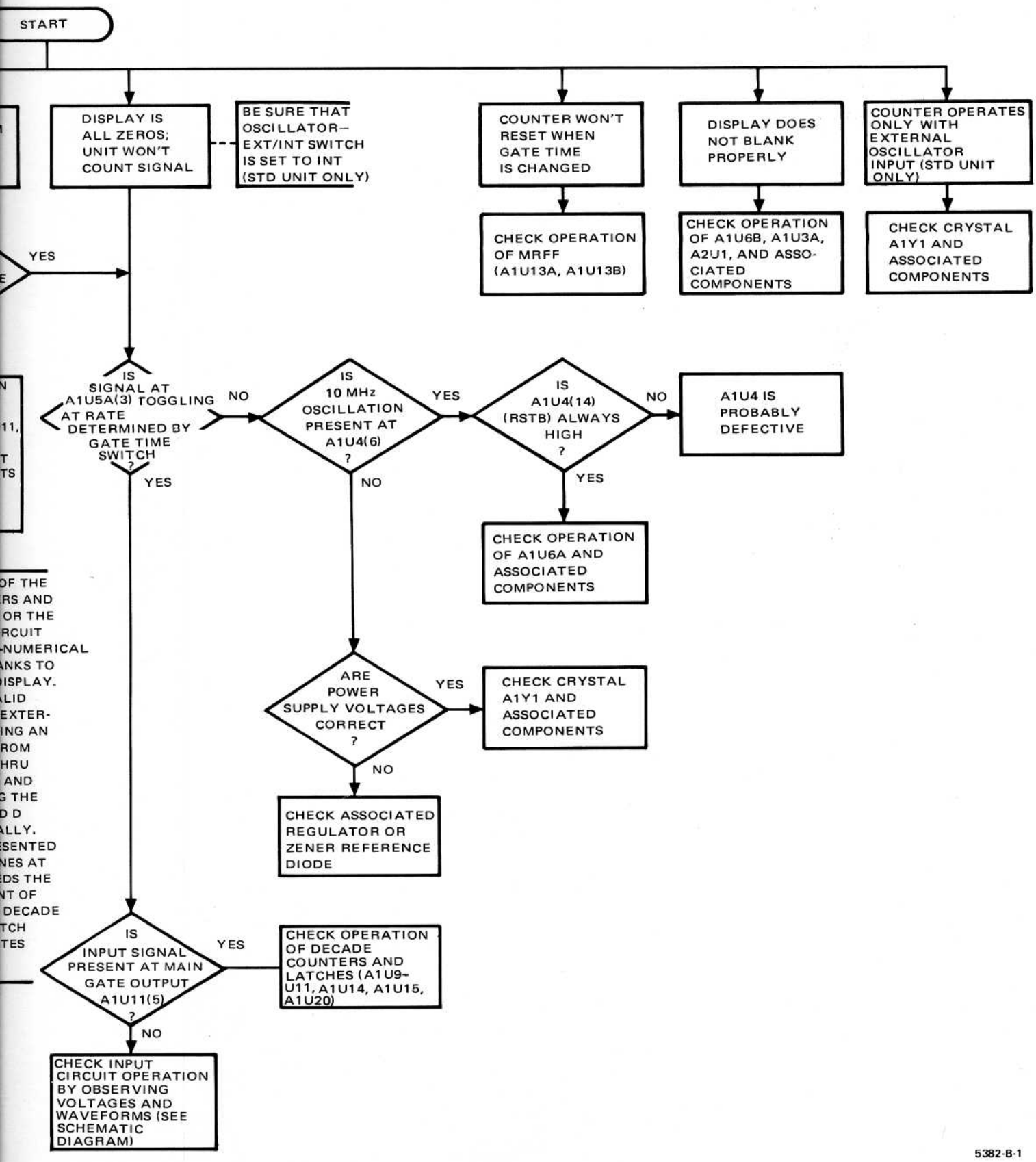

START
DISPLAY IS ALL ZEROS; UNIT WON'T COUNT SIGNAL
BE SURE THAT OSCILLATOR–EXT/INT SWITCH IS SET TO INT (STD UNIT ONLY)
COUNTER WON'T RESET WHEN GATE TIME IS CHANGED
DISPLAY DOES NOT BLANK PROPERLY
COUNTER OPERATES ONLY WITH EXTERNAL OSCILLATOR INPUT (STD UNIT ONLY)
CHECK OPERATION OF MRFF (A1U13A, A1U13B)
CHECK OPERATION OF A1U6B, A1U3A, A2U1, AND ASSOCIATED COMPONENTS
CHECK CRYSTAL A1Y1 AND ASSOCIATED COMPONENTS
YES
IS SIGNAL AT A1U5A(3) TOGGLING AT RATE DETERMINED BY GATE TIME SWITCH ?
NO
IS 10 MHz OSCILLATION PRESENT AT A1U4(6) ?
YES
IS A1U4(14) (RSTB) ALWAYS HIGH ?
NO
A1U4 IS PROBABLY DEFECTIVE
YES
CHECK OPERATION OF A1U6A AND ASSOCIATED COMPONENTS
NO
ARE POWER SUPPLY VOLTAGES CORRECT ?
YES
CHECK CRYSTAL A1Y1 AND ASSOCIATED COMPONENTS
NO
CHECK ASSOCIATED REGULATOR OR ZENER REFERENCE DIODE
YES
IS INPUT SIGNAL PRESENT AT MAIN GATE OUTPUT A1U11(5) ?
YES
CHECK OPERATION OF DECADE COUNTERS AND LATCHES (A1U9-U11, A1U14, A1U15, A1U20)
NO
CHECK INPUT CIRCUIT OPERATION BY OBSERVING VOLTAGES AND WAVEFORMS (SEE SCHEMATIC DIAGRAM)
5382-B-1

Figure 3-2. Troubleshooting Flow Chart

3-47. ORDERING INFORMATION

3-48. To obtain replacement parts, address order to your local Hewlett-Packard Sales and Service Office (see lists at the back of this manual for addresses). Identify parts by their Hewlett-Packard part number. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

3-49. SCHEMATIC DIAGRAM

3-50. Figure 3-3 defines the symbols and reference designation arrangement used on the schematic diagram of Figure 3-6. Additional information in the form of a timing diagram, Figure 3-4, a signal mnemonic definition list, Table 3-5, and component locator illustrations, Figure 3-5, precede the schematic diagram of Figure 3-6.

REFERENCE DESIGNATIONS

A	= assembly	F	= miscellaneous electrical part	P	= electrical connector (movable portion); plug	U	= integrated circuit; microcircuit
AT	= attenuator; isolator; termination	F	= fuse			V	= electron tube
B	= fan; motor	FL	= filter	Q	= transistor; SCR; triode thyristor	VR	= voltage regulator; breakdown diode
BT	= battery	H	= hardware				
C	= capacitor	HY	= circulator	R	= resistor	W	= cable; transmission path; wire
CP	= coupler	J	= electrical connector (stationary portion); jack	RT	= thermistor	X	= socket
CR	= diode; diode thyristor; varactor			S	= switch	Y	= crystal unit-piezoelectric
DC	= directional coupler	K	= relay	T	= transformer		
DL	= delay line	L	= coil; inductor	TB	= terminal board	Z	= tuned cavity; tuned circuit
DS	= annunciator; signaling device (audible or visual); lamp; LED	M	= meter	TC	= thermocouple		
		MP	= miscellaneous mechanical part	TP	= test point		

ABBREVIATIONS

A	= ampere	avg	= average	CHAN	= channel	dc	= direct current
ac	= alternating current	AWG	= American wire gauge	cm	= centimeter	deg	= degree (temperature interval or difference)
ACCESS	= accessory			CMO	= cabinet mount only		
ADJ	= adjustment	BAL	= balance	COAX	= coaxial	...°	= degree (plane angle)
A/D	= analog-to-digital	BCD	= binary coded decimal	COEF	= coefficient	°C	= degree Celsius (centigrade)
AF	= audio frequency			COM	= common		
AFC	= automatic frequency control	BD	= board	COMP	= composition	°F	= degree Fahrenheit
		BE CU	= beryllium copper	COMPL	= complete	°K	= degree Kelvin
AGC	= automatic gain control	BFO	= beat frequency oscillator	CONN	= connector	DEPC	= deposited carbon
				CP	= cadmium plate	DET	= detector
AL	= aluminum	BH	= binder head	CRT	= cathode-ray tube	diam	= diameter
ALC	= automatic level control	BKDN	= breakdown	CTL	= complementary transistor logic	DIA	= diameter (used in parts list)
		BP	= bandpass				
AM	= amplitude modulation	BPF	= bandpass filter	CW	= continuous wave	DIFF AMPL	= differential amplifier
		BRS	= brass	cw	= clockwise		
AMPL	= amplifier	BWO	= backward-wave oscillator	cm	= centimeter	div	= division
APC	= automatic phase control			D/A	= digital-to-analog	DPDT	= double-pole, double-throw
		CAL	= calibrate	dB	= decibel		
ASSY	= assembly	ccw	= counterclockwise	dBm	= decibel referred to 1 mW	DR	= drive
AUX	= auxiliary	CER	= ceramic				

ABBREVIATIONS

DSB	= double sideband
DTL	= diode transistor logic
DVM	= digital voltmeter
ECL	= emitter coupled logic
EMF	= electromotive force
EDP	= electronic data processing
ELECT	= electrolytic
ENCAP	= encapsulated
EXT	= external
F	= farad
FET	= field-effect transistor
F/F	= flip-flop
FH	= flat head
FIL H	= fillister head
FM	= frequency modulation
FP	= front panel
FREQ	= frequency
FXD	= fixed
g	= gram
GE	= germanium
GHz	= gigahertz
GL	= glass
GND	= ground(ed)
H	= henry
h	= hour
HET	= heterodyne
HEX	= hexagonal
HD	= head
HDW	= hardware
HF	= high frequency
HG	= mercury
HI	= high
HP	= Hewlett-Packard
HPF	= high pass filter
HR	= hour (used in parts list)
HV	= high voltage
Hz	= Hertz
IC	= integrated circuit
ID	= inside diameter
IF	= intermediate frequency
IMPG	= impregnated
in	= inch
INCD	= incandescent
INCL	= include(s)
INP	= input
INS	= insulation
INT	= internal
kg	= kilogram
kHz	= kilohertz
kΩ	= kilohm
kV	= kilovolt
lb	= pound
LC	= inductance-capacitance
LED	= light-emitting diode
LF	= low frequency
LG	= long
LH	= left hand
LIM	= limit
LIN	= linear taper (used in parts list)
lin	= linear
LK	
WASH	= lock washer
LO	= low; local oscillator
LOG	= logarithmic taper (used in parts list)
log	= logarithm(ic)
LPF	= low pass filter
LV	= low voltage
m	= meter (distance)
mA	= milliampere
MAX	= maximum
MΩ	= megohm
MEG	= meg (10^6) (used in parts list)
MET FLM	= metal film
MET OX	= metal oxide
MF	= medium frequency; microfarad (used in parts list)
MFR	= manufacturer
mg	= milligram
MHz	= megahertz
mH	= millihenry
mho	= mho
MIN	= minimum
min	= minute (time)
′	= minute (plane angle)
MINAT	= miniature
mm	= millimeter
MOD	= modulator
MOM	= momentary
MOS	= metal-oxide semiconductor
ms	= millisecond
MTG	= mounting
MTR	= meter (indicating device)
mV	= millivolt
mVac	= millivolt, ac
mVdc	= millivolt, dc
mVpk	= millivolt, peak
mV p-p	= millivolt, peak-to-peak
mVrms	= millivolt, rms
mW	= milliwatt
MUX	= multiplex
MY	= mylar
μA	= microampere
μF	= microfarad
μH	= microhenry
μmho	= micromho
μs	= microsecond
μV	= microvolt
μVac	= microvolt, ac
μVdc	= microvolt, dc
μVpk	= microvolt, peak
μVp-p	= microvolt, peak-to-peak
μVrms	= microvolt, rms
μW	= microwatt
nA	= nanoampere
NC	= no connection
N/C	= normally closed
NE	= neon
NEG	= negative
nF	= nanofarad
NI PL	= nickel plate
N/O	= normally open
NOM	= nominal
NORM	= normal
NPN	= negative-positive-negative
NPO	= negative-positive zero (zero temperature coefficient)
NRFR	= not recommended for field replacement
NSR	= not separately replaceable
ns	= nanosecond
nW	= nanowatt
OBD	= order by description
OD	= outside diameter
OH	= oval head
OP AMPL	= operational amplifier
OPT	= option
OSC	= oscillator
OX	= oxide
oz	= ounce
Ω	= ohm
P	= peak (used in parts list)
PAM	= pulse-amplitude modulation
PC	= printed circuit
PCM	= pulse-code modulation; pulse-count modulation
PDM	= pulse-duration modulation
pF	= picofarad
PH BRZ	= phosphor bronze
PHL	= Phillips
PIN	= positive-instrinsic-negative
PIV	= peak inverse voltage
pk	= peak
PL	= phase lock
PLO	= phase lock oscillator
PM	= phase modulation
PNP	= positive-negative-positive
P/O	= part of
POLY	= polystyrene
PORC	= porcelain
POS	= positive; position(s) (used in parts list)
POSN	= position
POT	= potentiometer
p-p	= peak-to-peak
PP	= peak-to-peak (used in parts list)
PPM	= pulse-position modulation
PREAMPL	= preamplifier
PRF	= pulse-repetition frequency
PRR	= pulse repetition rate
ps	= picosecond
PT	= point
PTM	= pulse-time modulation
PWM	= pulse-width modulation
PWV	= peak working voltage
RC	= resistance capacitance
RECT	= rectifier
REF	= reference
REG	= regulated
REPL	= replaceable
RF	= radio frequency
RFI	= radio frequency interference
RH	= round head; right hand
RLC	= resistance-inductance-capacitance
RMO	= rack mount only
rms	= root-mean-square
RND	= round
ROM	= read-only memory
R&P	= rack and panel
RWV	= reverse working voltage
S	= scattering parameter
s	= second (time)
″	= second (plane angle)
S-B	= slow-blow (fuse) (used in parts list)
SCR	= silicon controlled rectifier; screw
SE	= selenium
SECT	= sections
SEMICON	= semiconductor
SHF	= superhigh frequency
SI	= silicon
SIL	= silver
SL	= slide
SNR	= signal-to-noise ratio
SPDT	= single-pole, double-throw
SPG	= spring
SR	= split ring
SPST	= single-pole, single-throw
SSB	= single sideband
SST	= stainless steel
STL	= steel
SQ	= square
SWR	= standing-wave ratio
SYNC	= synchronize
T	= timed (slow-blow fuse)
TA	= tantalum
TC	= temperature compensating
TD	= time delay
TERM	= terminal
TFT	= thin-film transistor
TGL	= toggle
THD	= thread
THRU	= through
TI	= titanium
TOL	= tolerance
TRIM	= trimmer
TSTR	= transistor
TTL	= transistor-transistor logic
TV	= television
TVI	= television interference
TWT	= traveling wave tube
U	= micro (10^{-6}) (used in parts list)
UF	= microfarad (used in parts list)
UHF	= ultrahigh frequency
UNREG	= unregulated
V	= volt
VA	= voltampere
Vac	= volts, ac
VAR	= variable
VCO	= voltage-controlled oscillator
Vdc	= volts, dc
VDCW	= volts, dc, working (used in parts list)
V(F)	= volts, filtered
VFO	= variable-frequency oscillator
VHF	= very-high frequency
Vpk	= volts, peak
Vp-p	= volts, peak-to-peak
Vrms	= volts, rms
VSWR	= voltage standing wave ratio
VTO	= voltage-tuned oscillator
VTVM	= vacuum-tube voltmeter
V(X)	= volts, switched
W	= watt
W	= with
WIV	= working inverse voltage
WW	= wirewound
W/O	= without
YIG	= yttrium-iron-garnet
Zo	= characteristic impedance

NOTE

All abbreviations in the parts list will be in upper case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 3-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	05382-60001 *	1	BOARD ASSY, MAIN	28480	05382-60001
C1	0180-0480	2	CAPACITOR-FXD; 0UF+75-10% 25VDC AL	56289	36DX452G025AA2A
C2	0180-0480		CAPACITOR-FXD; 0UF+75-10% 25VDC AL	56289	36DX452G025AA2A
C3	0180-0058	1	CAPACITOR-FXD; 50UF+75-10% 25VDC AL	56289	30D506G025CC2
C4	0180-0106	5	CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
C5	0180-1701	6	CAPACITOR-FXD; 6.8UF+-20% 6VDC TA-SOLID	56289	150D685X0006A2
C6 **	0121-0059	1	CAPACITOR; VAR; TRMR; CER; 2/8PF	73899	DV11PR8A
C7 **	0160-2265	1	CAPACITOR-FXD 22PF+-5% 500WVDC	28480	0160-2265
C8 **	0180-1701		CAPACITOR-FXD; 6.8UF+-20% 6VDC TA-SOLID	56289	150D685X0006A2
C9 **	0160-3060	1	CAPACITOR-FXD .1UF+-20% 25WVDC	28480	0160-3060
C10**	0160-2146	1	CAPACITOR-FXD .02UF+80-20% 100WVDC	28480	0160-2146
C11	0180-1735	1	CAPACITOR-FXD; .22UF+-10% 35VDC TA	56289	150D224X9035A2
C12	0180-0106		CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
C13	0180-1701		CAPACITOR-FXD; 6.8UF+-20% 6VDC TA-SOLID	56289	150D685X0006A2
C14	0160-3879	10	CAPACITOR-FXD .01UF+-20% 100WVDC	28480	0160-3879
C15	0150-0075	5	CAPACITOR-FXD .0047UF+100-20% 500WVDC	28480	0150-0075
C16	0160-3879		CAPACITOR-FXD .01UF+-20% 100WVDC	28480	0160-3879
C17	0150-0075		CAPACITOR-FXD .0047UF+100-20% 500WVDC	28480	0150-0075
C18	0160-3879		CAPACITOR-FXD .01UF+-20% 100WVDC	28480	0160-3879
C19	0160-3879		CAPACITOR-FXD .01UF+-20% 100WVDC	28480	0160-3879
C20	0160-3879		CAPACITOR-FXD .01UF+-20% 100WVDC	28480	0160-3879
C21	0150-0075		CAPACITOR-FXD .0047UF+100-20% 500WVDC	28480	0150-0075
C22	0160-3879		CAPACITOR-FXD .01UF+-20% 100WVDC	28480	0160-3879
C23	0160-3875	1	CAPACITOR-FXD 22PF+-5% 200WVDC	28480	0160-3875
C24	0160-3879		CAPACITOR-FXD .01UF+-20% 100WVDC	28480	0160-3879
C25	0180-1701		CAPACITOR-FXD; 6.8UF+-20% 6VDC TA-SOLID	56289	150D685X0006A2
C26	0160-3879		CAPACITOR-FXD .01UF+-20% 100WVDC	28480	0160-3879
C27	0150-0075		CAPACITOR-FXD .0047UF+100-20% 500WVDC	28480	0150-0075
C28	0160-3879		CAPACITOR-FXD .01UF+-20% 100WVDC	28480	0160-3879
C29	0160-3879		CAPACITOR-FXD .01UF+-20% 100WVDC	28480	0160-3879
C30	0180-0106		CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
C31	0180-0106		CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
C32	0180-1701		CAPACITOR-FXD; 6.8UF+-20% 6VDC TA-SOLID	56289	150D685X0006A2
C33	0150-0093	2	CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
C34	0150-0093		CAPACITOR-FXD .01UF+80-20% 100WVDC	28480	0150-0093
C35	0180-1701		CAPACITOR-FXD; 6.8UF+-20% 6VDC TA-SOLID	56289	150D685X0006A2
C36	0150-0075		CAPACITOR-FXD .0047UF+100-20% 500WVDC	28480	0150-0075
CR1	1906-0028	1	DIODE; MULT; FULL WAVE BRIDGE RECTIFIER	04713	MDA922-3
CR2	1902-0551	2	DIODE; ZENER; 6.19V VZ; 1W MAX PD	04713	SZ 11213-80
CR3	1901-0028	1	DIODE-PWR RECT 400V 750MA	04713	SR1358-9
CR4	1902-0202	1	DIODE; ZENER; 15V VZ; 1W MAX PD	04713	SZ11213-191
CR5	1902-0551		DIODE; ZENER; 6.19V VZ; 1W MAX PD	04713	SZ 11213-80
CR6**	1901-0040	6	DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
CR7**	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
CR8	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
CR9	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
CR10	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
L1	9100-1788	4	COIL; FXD; NON-MOLDED RF CHOKE; .75UH	02114	VK200-20/4B
L2	9100-1788		COIL; FXD; NON-MOLDED RF CHOKE; .75UH	02114	VK200-20/4B
L3	9100-1788		COIL; FXD; NON-MOLDED RF CHOKE; .75UH	02114	VK200-20/4B
L4	9100-1788		COIL; FXD; NON-MOLDED RF CHOKE; .75UH	02114	VK200-20/4B
L5	9100-2269	2	COIL; FXD; MOLDED RF CHOKE; 27UH 10%	24226	10/272
L6	9100-2269		COIL; FXD; MOLDED RF CHOKE; 27UH 10%	24226	10/272
Q1 **	1853-0015	2	TRANSISTOR PNP SI CHIP PD=200MW	28480	1853-0015
Q2 **	1853-0015		TRANSISTOR PNP SI CHIP PD=200MW	28480	1853-0015
Q3	1853-0036	1	TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
Q4	1854-0092	5	TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
Q5	1854-0092		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
Q6	1854-0092		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
Q7	1854-0092		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
Q8	1854-0215	1	TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
Q9	1854-0345	3	TRANSISTOR NPN 2N5179 SI PD=200MW	04713	2N5179
Q10	1854-0345		TRANSISTOR NPN 2N5179 SI PD=200MW	04713	2N5179
Q11	1854-0345		TRANSISTOR NPN 2N5179 SI PD=200MW	04713	2N5179
Q12	1854-0071	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q13	1854-0092		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
Q14	1855-0081	2	TRANSISTOR; J-FET N-CHAN, D-MODE SI	01295	2N5245
Q15	1855-0081		TRANSISTOR; J-FET N-CHAN, D-MODE SI	01295	2N5245
R1	0761-0022	1	RESISTOR 620 OHM 5% 1W MO TUBULAR	24546	FP32-1-T00-621-J
R2 **	0683-3905	2	RESISTOR 39 OHM 5% .25W CC TUBULAR	01121	CB3905
R3 **	0683-5115	9	RESISTOR 510 OHM 5% .25W CC TUBULAR	01121	CB5115
R4 **	0683-5115		RESISTOR 510 OHM 5% .25W CC TUBULAR	01121	CB5115
R5 **	0683-2415	1	RESISTOR 240 OHM 5% .25W CC TUBULAR	01121	CB2415

*OPTION 001 05382-60003
**THESE PARTS NOT IN OPTION 001

See introduction to this section for ordering information

Table 3-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R6 **	0683-5115		RESISTOR 510 OHM 5% .25W CC TUBULAR	01121	CB5115
R7 **	0683-1025	4	RESISTOR 1K 5% .25W CC TUBULAR	01121	CB1025
R8 **	0683-5115		RESISTOR 510 OHM 5% .25W CC TUBULAR	01121	CB5115
R9 **	0683-2035	2	RESISTOR 20K 5% .25W CC TUBULAR	01121	CB2035
R10**	0683-5105	1	RESISTOR 51 OHM 5% .25W CC TUBULAR	01121	CB5105
R11**	0683-7515	1	RESISTOR 750 OHM 5% .25W CC TUBULAR	01121	CB7515
R12**	0683-2035		RESISTOR 20K 5% .25W CC TUBULAR	01121	CB2035
R13**	0683-1025		RESISTOR 1K 5% .25W CC TUBULAR	01121	CB1025
R14**	0683-1025		RESISTOR 1K 5% .25W CC TUBULAR	01121	CB1025
R15	0683-5125	2	RESISTOR 5.1K 5% .25W CC TUBULAR	01121	CB5125
R16	0683-2015	2	RESISTOR 200 OHM 5% .25W CC TUBULAR	01121	CB2015
R17	0683-5125		RESISTOR 5.1K 5% .25W CC TUBULAR	01121	CB5125
R18	0683-1035	2	RESISTOR 10K 5% .25W CC TUBULAR	01121	CB1035
R19	0683-3905		RESISTOR 39 OHM 5% .25W CC TUBULAR	01121	CB3905
R20	1810-0080	1	RESISTOR-MULTIPLE 500Ω(7)	28480	1810-0080
R21	0683-5115		RESISTOR 510 OHM 5% .25W CC TUBULAR	01121	CB5115
R22	0683-1035		RESISTOR 10K 5% .25W CC TUBULAR	01121	CB1035
R23	1810-0055	2	RESISTOR-MULTIPLE 10K (8)	28480	1810-0055
R24	0683-1025		RESISTOR 1K 5% .25W CC TUBULAR	01121	CB1025
R25	0683-3925	2	RESISTOR 3.9K 5% .25W CC TUBULAR	01121	CB3925
R26	0683-2015		RESISTOR 200 OHM 5% .25W CC TUBULAR	01121	CB2015
R27	0683-3925		RESISTOR 3.9K 5% .25W CC TUBULAR	01121	CB3925
R28	0698-5176	3	RESISTOR 510 OHM 5% .125W CC TUBULAR	01121	BB5115
R29	0698-5176		RESISTOR 510 OHM 5% .125W CC TUBULAR	01121	BB5115
R30	0698-5174	4	RESISTOR 200 OHM 5% .125W CC TUBULAR	01121	BB2015
R31	0698-4130	1	RESISTOR 39 OHM 5% .125W CC TUBULAR	01121	BB3905
R32	0698-3374	2	RESISTOR 20 OHM 5% .125W CC TUBULAR	01121	BB2005
R33	0698-3374		RESISTOR 20 OHM 5% .125W CC TUBULAR	01121	BB2005
R34	0698-5562	3	RESISTOR 120 OHM 5% .125W CC TUBULAR	01121	BB1215
R35	0698-5174		RESISTOR 200 OHM 5% .125W CC TUBULAR	01121	BB2015
R36	0698-5174		RESISTOR 200 OHM 5% .125W CC TUBULAR	01121	BB2015
R37	0698-5562		RESISTOR 120 OHM 5% .125W CC TUBULAR	01121	BB1215
R38	0698-5176		RESISTOR 510 OHM 5% .125W CC TUBULAR	01121	BB5115
R39	0674-3315	1	RESISTOR 330 OHM 5% .125W CC TUBULAR	01121	BB3315
R40	0698-5174		RESISTOR 200 OHM 5% .125W CC TUBULAR	01121	BB2015
R41	0698-5562		RESISTOR 120 OHM 5% .125W CC TUBULAR	01121	BB1215
R42	2100-3210	1	RESISTOR; VAR; TRMR; 10KOHM 10% C	32997	3389P-1-103
R43	0683-3935	1	RESISTOR 39K 5% .25W CC TUBULAR	01121	CB3935
R44	0683-5115		RESISTOR 510 OHM 5% .25W CC TUBULAR	01121	CB5115
R45	0683-5115		RESISTOR 510 OHM 5% .25W CC TUBULAR	01121	CB5115
R46	0683-3345	1	RESISTOR 330K 5% .25W CC TUBULAR	01121	CB3345
R47	0698-6283	1	RESISTOR 10 OHM 5% .125W CC TUBULAR	01121	BB1005
R48	0683-1005	1	RESISTOR 10 OHM 5% .25W CC TUBULAR	01121	CB1005
R49	0683-5115		RESISTOR 510 OHM 5% .25W CC TUBULAR	01121	CB5115
R50	0683-5115		RESISTOR 510 OHM 5% .25W CC TUBULAR	01121	CB5115
R51	1810-0055		RESISTOR-MULTIPLE 10K (8)	28480	1810-0055
S1 **	3101-1667	1	SWITCH; SL; SPDT NS; .5A 125VAC	28480	3101-1667
S2	3101-0680	1	SWITCH; PB 1-STA MODULE 4PDT	28480	3101-0680
U1 **	1820-1224	1	IC;DGTL;LINE RECEIVER	04713	MC10216P
U2	1820-0661	1	IC;DGTL;GATE	01295	SN7432N
U3	1820-0537	1	IC;DGTL;SCHMITT TRIGGER	01295	SN7413N
U4	1820-0633	1	IC:M.O.S. TIME BASE	28480	1820-0633
U5	1820-0817	1	IC;DGTL;FLIP-FLOP	04713	MC10131P
U6	1820-0077	1	IC;DGTL;FLIP-FLOP	01295	SN7474N
U7	1820-0681	1	IC;DGTL;GATE	01295	SN74S00N
U8	1820-0269	2	IC;DGTL;GATE	01295	SN7403N
U9	1820-0301	2	IC;DGTL;LATCH	01295	SN7475N
U10	1820-1052	1	IC;DGTL;TRANSLATOR (LOGIC LEVEL)	04713	MC10125L
U11	1820-1019	1	IC;DGTL;COUNTER	28480	1820-1019
U12	1820-0233	1	IC;DGTL;COUNTER	01295	SN74193N
U13	1820-0328	1	IC;DGTL;GATE	01295	SN7402N
U14	1820-0634	1	IC:M.O.S.,6-DECADE COUNTER	28480	1820-0634
U15	1820-0751	1	IC;DGTL;COUNTER	01295	SN74196N
U16	1820-0920	1	IC;DGTL;LINE RECEIVER	04713	MC1692L
U17	1820-0214	1	IC;DGTL;DECODER/DECODER DRVR/DATA DISTR	01295	SN7442N
U18	1820-0174	1	IC;DGTL;INVERTER	01295	SN7404N
U19	1820-0269		IC;DGTL;GATE	01295	SN7403N
U20	1820-0301		IC;DGTL;LATCH	01295	SN7475N
U21	1826-0122	1	IC;LIN;VOLTAGE REGULATOR	07263	7805UC
U22	1826-0215	1	IC;LIN;VOLTAGE REGULATOR	04713	MC7905.2CP
Y1 **	0410-0405	1	CRYSTAL:QUARTZ 10 MHZ	28480	0410-0405
A2	05382-60002	1	BOARD ASSY, DISPLAY	28480	05382-60002

*OPTION 001 05382-60003
**THESE PARTS NOT IN OPTION 001

See introduction to this section for ordering information

Table 3-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2	05382-60002	1	BOARD ASSY, DISPLAY	28480	05382-60002
C1	0180-0106	1	CAPACITOR-FXD; 60UF+-20% 6VDC TA-SOLID	56289	150D606X000682
C2	0140-0149	1	CAPACITOR-FXD 470PF+-5% 300WVDC	72136	DM15F471J0300WV1CR
C3	0160-0182	1	CAPACITOR-FXD 47PF+-5% 300WVDC	28480	0160-0182
C4	0160-2254	1	CAPACITOR-FXD 7.5PF+-.25PF 500WVDC	28480	0160-2254
C5	0160-4182		CAPACITOR-FXD .01UF+-20% 200WVDC	72982	8121-M200-X7R-103M
CR1	1901-0040	8	DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
DS1	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
DS2	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
DS3	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
DS4	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
DS5	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
DS6	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
DS7	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
DS8	1990-0452		DISPLAY NUM SEG 1 CHAR .3 IN HIGH	28480	1990-0452
J1	1250-1163	1	CONNECTOR-COAX; BNC; 50 OHM FEMALE	28480	1250-1163
	1251-3768	26	POST (F) CONNECT	28480	1251-3768
	0510-0076	3	NUT; SH MET 6-32 .63; STL; CD PL	78553	C8599-632-248
L1	9100-1620	1	COIL; FXD; MOLDED RF CHOKE; 15UH 10%	24226	15/152
Q1	1853-0318	8	TRANSISTOR PNP SI CHIP PD=500MW	28480	1853-0318
Q2	1853-0318		TRANSISTOR PNP SI CHIP PD=500MW	28480	1853-0318
Q3	1853-0318		TRANSISTOR PNP SI CHIP PD=500MW	28480	1853-0318
Q4	1853-0318		TRANSISTOR PNP SI CHIP PD=500MW	28480	1853-0318
Q5	1853-0318		TRANSISTOR PNP SI CHIP PD=500MW	28480	1853-0318
Q6	1853-0318		TRANSISTOR PNP SI CHIP PD=500MW	28480	1853-0318
Q7	1853-0318		TRANSISTOR PNP SI CHIP PD=500MW	28480	1853-0318
Q8	1853-0318		TRANSISTOR PNP SI CHIP PD=500MW	28480	1853-0318
R1	0683-4705	13	RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R2	0683-4705		RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R3	0683-4705		RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R4	0683-4705		RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R5	0683-4705		RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R6	0683-4705		RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R7	0683-4705		RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R8	0683-4705		RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R9	0683-4705		RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R10	0683-4705		RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R11	0683-4705	8	RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R12	0683-4715		RESISTOR 470 OHM 5% .25W CC TUBULAR	01121	CB4715
R13	0683-4715		RESISTOR 470 OHM 5% .25W CC TUBULAR	01121	CB4715
R14	0683-4715		RESISTOR 470 OHM 5% .25W CC TUBULAR	01121	CB4715
R15	0683-4715		RESISTOR 470 OHM 5% .25W CC TUBULAR	01121	CB4715
R16	0683-4715		RESISTOR 470 OHM 5% .25W CC TUBULAR	01121	CB4715
R17	0683-4715		RESISTOR 470 OHM 5% .25W CC TUBULAR	01121	CB4715
R18	0683-4715		RESISTOR 470 OHM 5% .25W CC TUBULAR	01121	CB4715
R19	0683-4715		RESISTOR 470 OHM 5% .25W CC TUBULAR	01121	CB4715
R20	1810-0041	1	CIRCUIT; PSIV; NON-RPRABLE IN	28480	1810-0041
R21	0683-9125	1	RESISTOR 9.1K 5% .25W CC TUBULAR	01121	CB9125
R22	0683-9135	1	RESISTOR 91K 5% .25W CC TUBULAR	01121	CB9135
R23	0683-9145		RESISTOR 910K 5% .25W CC TUBULAR	01121	CB9145
R24	0683-4705		RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
R25	0683-4705		RESISTOR 47 OHM 5% .25W CC TUBULAR	01121	CB4705
S1	3101-1598	2	SWITCH; SL; DP3T NS; 1A 125VAC	28480	3101-1598
S2	3101-1598		SWITCH; SL; DP3T NS; 1A 125VAC	28480	3101-1598
U1	1820-1037	1	IC;DGTL;DECODER/DECODER DRVR/DATA DISTR	01295	SN7446AN

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Table 3-3. Replaceable Parts (Continued)

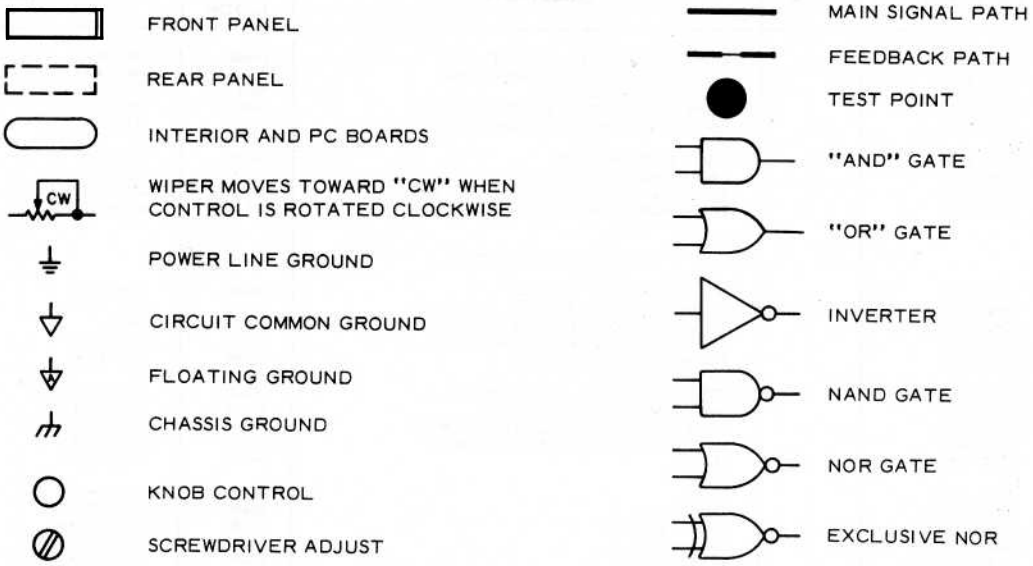
Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
C1A	0160-3043	2	CAPACITOR-FXD .005UF/.005UF+-20%	28480	0160-3043
C1B	0160-3043		CAPACITOR-FXD .005UF/.005UF+-20%	28480	0160-3043
F1	2110-0018	1	FUSE .25A 125V SLO-BLO	75915	313.250
J1	1251-2357	1	CONNECTOR; AC PWR; HP-9 MALE FLANGE	28480	1251-2357
S2	3101-1609	1	SWITCH; SL; 2-DPDT NS; 3A 125VAC	82389	11E-1036
T1	9100-3039	1	TRANSFORMER, POWER	28480	9100-3039
W1	8120-1348	1	CABLE; UNSHLD 3-COND 18AWG	28480	8120-1348
XF1	2110-0464	1	FUSEHOLDER; EXTR POST? BAY CAP; 20A	75915	345002-010
XF2	2110-0465	1	FUSEHOLDER; CAP- FOR 3-AG FUSES	75915	345002-020
			MISCELLANEOUS PARTS		
	0340-0765	1	INSULATOR; XSTR; .002 THK	28480	0340-0765
	0360-0001	1	TERMINAL, SLDR LUG, 6 SCR, .141/.086 ID	78452	920
	0360-0353	2	TERMINAL, SLDR LUG, 6 SCR, .144/.144 ID	79963	176
	0370-0914	1	BEZEL:PUSHBUTTON KNOB, JADE GREY	28480	0370-0914
	0370-2486	1	PUSHBUTTON (SOLID GRAY)	28480	0370-2486
	0510-0002	2	PRESS-IN NUT; 6-32; .062 LG; .056 MIN	28480	0510-0002
	0510-0076		NUT; SH MET 6-32 .63; STL; CD PL	78553	C8599-632-248
	1250-0083	1	CONNECTOR-COAX; BNC; 50 OHM FEMALE	24931	28JR-130-1
	2950-0054	1	NUT; HEX 1/2-28 .125 X .625; BRS; NI PL	28480	2950-0054
	5040-7032	1	FOOT	28480	5040-7032
	05301-40001	1	FOOT	28480	05301-40001
	05381-20003	1	COVER, TOP	28480	05382-20003
	05381-20004	1	COVER, BOTTOM	28480	05381-20004
	05381-20005	4	STANDOFF	28480	05381-20005
	05382-00001	1	PANEL, FRONT	28480	05382-00001
	05382-00002	1	PANEL, REAR	28480	05382-00002
	05382-90001	1	MANUAL	28480	05382-90001
			OPTION 001 PARTS		
C37***	0150-0050	1	CAPACITOR-FXD .001 UF 1000V	28480	0150-0050
CR11***	1901-0040	2	DIODE-SWITCHING 30V 50MA	28480	1901-0040
CR12***	1901-0040		DIODE-SWITCHING 30V 50MA	28480	1901-0040
Q16***	1853-0015	1	TRANSISTOR--PNP SI 2N3640	07263	2N3640
R68***	0683-5115	1	RESISTOR-FXD 510 OHM .25W	01121	CB 5115
R69***	0683-1025	1	RESISTOR-FXD 1K OHM .25W	01121	CB 1025
R70***	0761-0035	1	RESISTOR-FXD 150 OHM 1W	24546	FP-32
U23***	0960-0394		OSCILLATOR-CRYSTAL TCXO	28480	0960-0394

***THESE PARTS ADDED IN OPTION 001

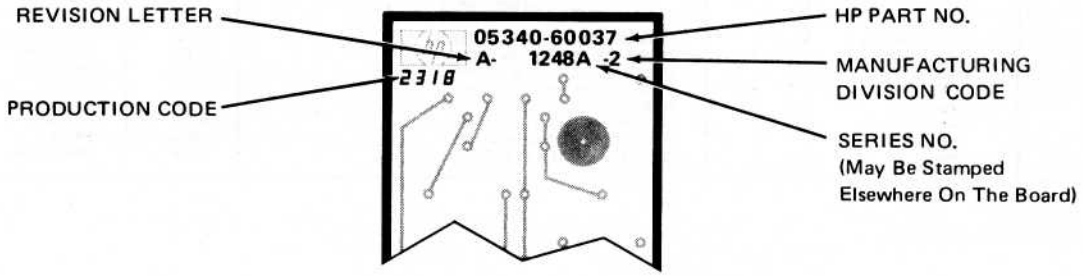
Table 3-4. Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
01121	Allen Bradley Co.	Milwaukee, Wi.	53212
01295	Texas Instr. Inc. Simicond Cmpnt. Div.	Dallas, Tx.	75231
02114	Ferroxcube Corp.	Saugerties, N.Y.	12477
04713	Motorola Semiconductor Products	Phoenix, Az.	85008
07263	Fairchild Semiconductor Div.	Mountain View, Ca.	94040
24226	Gowanda Electronics Corp.	Gowanda, N.Y.	14070
24546	Corning Glass Works	Bradford, Pa.	16701
24931	Specialty Connector Co., Inc.	Indianapolis, In.	46227
28480	Hewlett-Packard Co., Corporate Hq.	Palo Alto, Ca.	94304
32997	Bourns Inc. Trimpot Prod. Div.	Riverside, Ca.	92507
56289	Sprague Electric Co.	North Adams, Ma.	01247
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Ct.	06226
72982	Erie Technological Products, Inc.	Erie, Pa.	16512
73899	J. F. D. Electronics Corp.	Brooklyn, N.Y.	11219
75915	Littlefuse, Inc.	Des Plaines, Il.	60016
78452	Everlock Chicago Inc.	Chicago, Il.	60622
78553	Tinnerman Products Inc.	Cleveland, Oh.	44129
79963	Zierick Mfg. Co.	Mt. Kisco, N.Y.	10549
82389	Switchcraft Inc.	Chicago, Il.	60630

SYMBOLS



PRINTED CIRCUIT BOARD IDENTIFICATION



REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION. JACKS ARE THE STATIONARY CONNECTORS AND PLUGS ARE THE MORE MOVEABLE OF TWO CONNECTORS.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

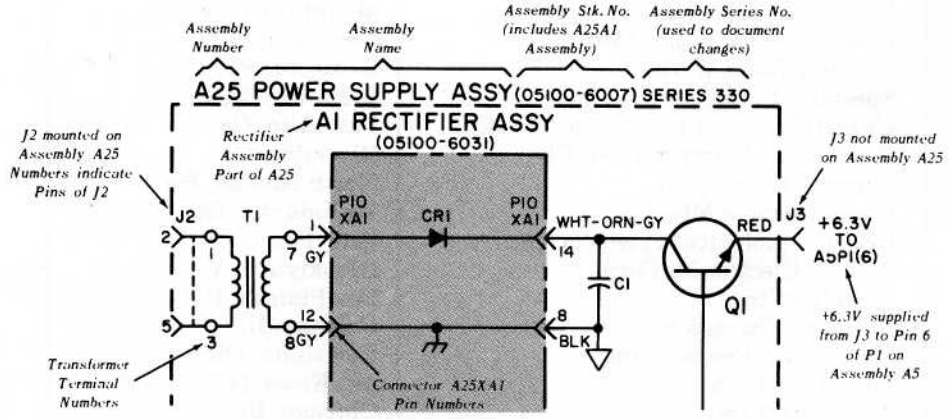


Figure 3-3. Schematic Diagram Notes

Table 3-5. Major Signal Definitions

Mnemonic	Description
DATA A DATA B DATA C DATA D	Four BCD signal lines upon which all display data is multiplexed.
$\overline{MG}$	Input to reset enable latch; low when main gate is open.
$\overline{MGE}$	Main gate control signal (ECL logic levels); low level opens main gate.
$\overline{MRS}$	Manual reset signal; low TTL level resets counter (generated by RS signal).
$\overline{OF}$	Overflow; low TTL level indicates overflow of decade counters.
RBI	Ripple Blanking Input; low TTL level allows blanking of zeros in display; high TTL level inhibits zero blanking.
RBO	Ripple Blanking Output; low TTL level when zeros are blanked from display; high TTL level at all other times.
RS	Momentary high TTL level resets counter when gate time is changed.
RSC	High TTL level resets six-decade counter during automatic reset cycle.
$\overline{RSC}$	Low TTL level resets decade counter A1U15 during automatic reset cycle.
RSE	High ECL level resets decade counter A1U11 and presets Schmitt trigger in input circuit during automatic reset cycle.
RSTB	High TTL level resets time base divider and main gate flip-flop during automatic reset cycle.
$\overline{S0}$ THRU $\overline{S7}$	Eight continuously cycling display scan lines; each scan line strobes one display digit.
TE	High ECL level inhibits the two least-significant outputs of decade counter A1U11 during the measurement cycle.
TR	High TTL level transfers data from the two, least-significant decade counters to the storage latches at the beginning of the reset cycle; also, clears the manual reset latch.
$\overline{TR}$	Low TTL level transfers data from the six-decade counter to the storage latches that are internal to the counter IC. Occurs at beginning of reset cycle.
W X Y Z	Outputs of down-counter A1U12. X,Y,Z used as output multiplexing address lines by six-decade counter A1U14 and as inputs to 4-to-10 line decoder, A1U17. W is used as timing signal for reset circuits.
$\overline{.1s}$ $\overline{1s}$ $\overline{10s}$	Low TTL levels illuminate the LED display decimal points. 1s and .1s control division factor of the time base divider, A1U4.

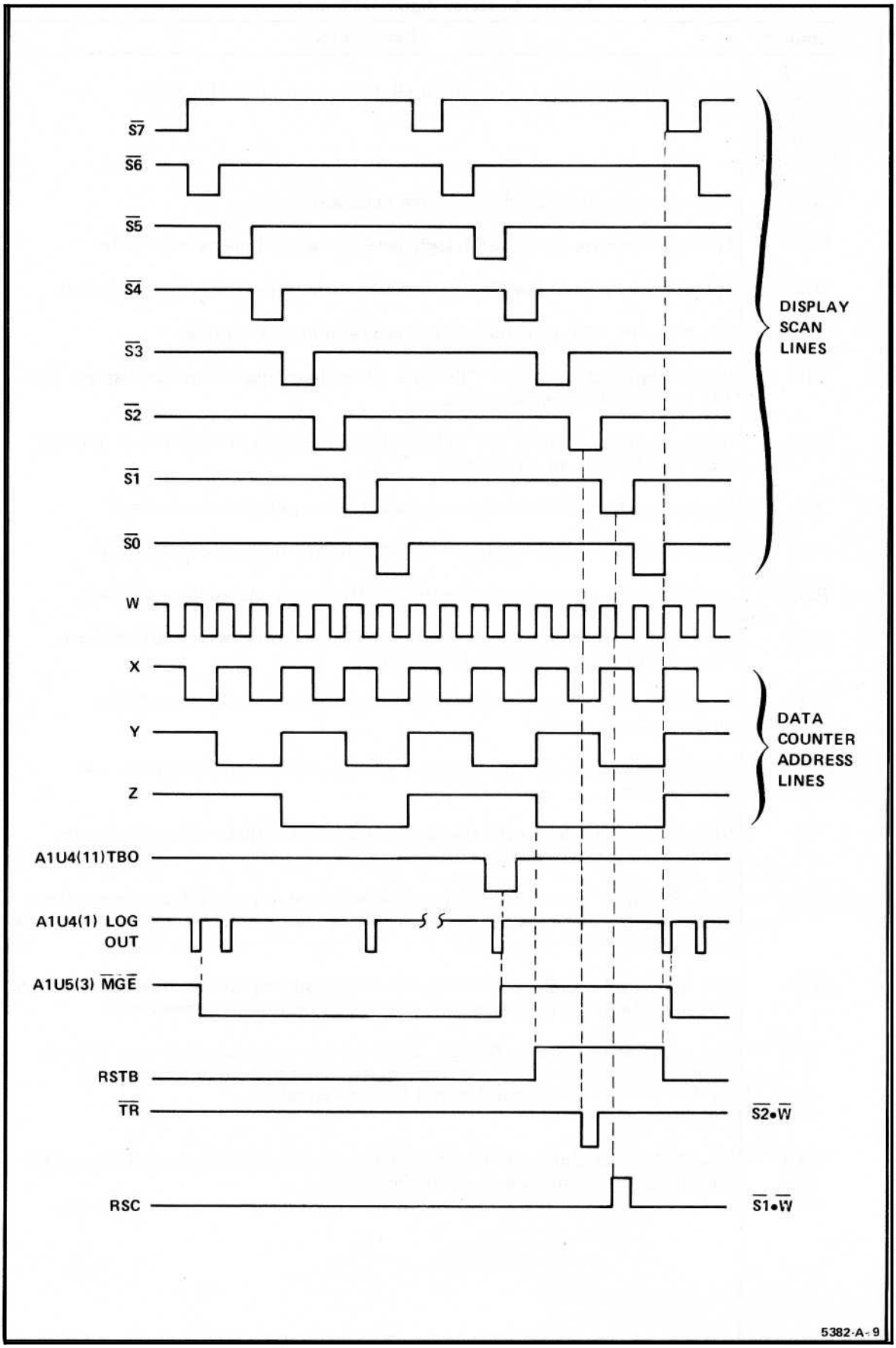
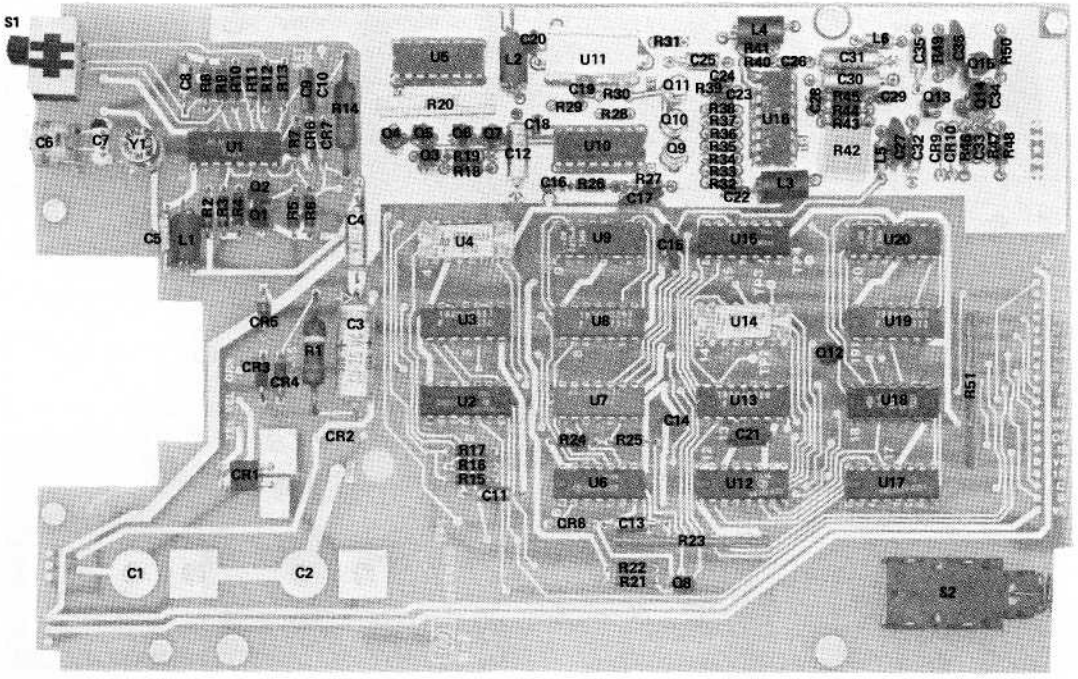


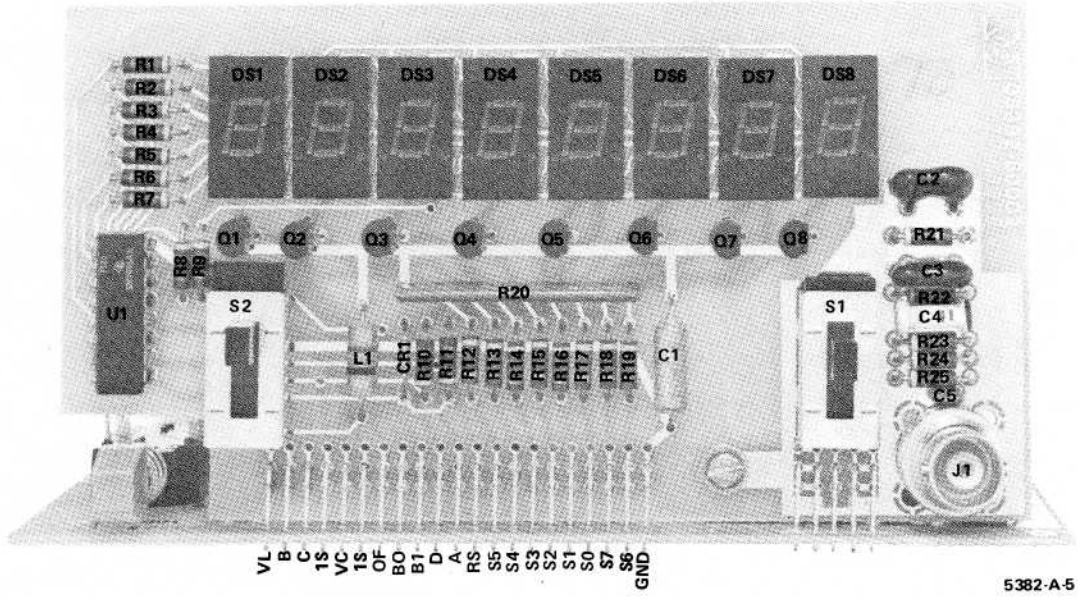
Figure 3-4. Instrument Timing Diagram

A1



5382-A-7

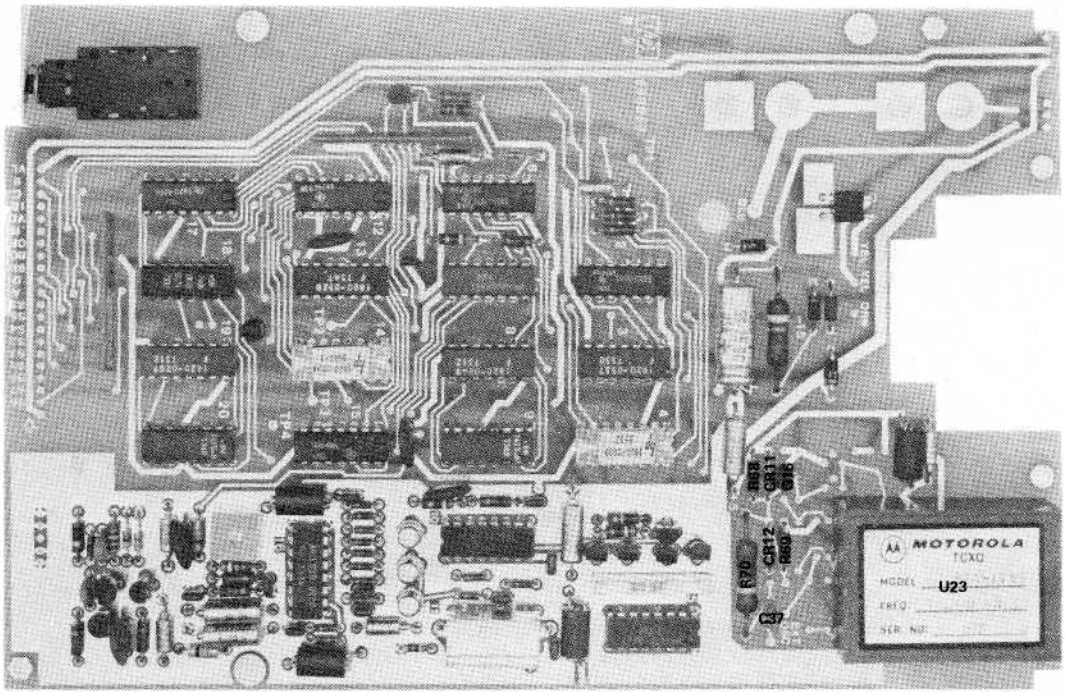
A2



5382-A-5

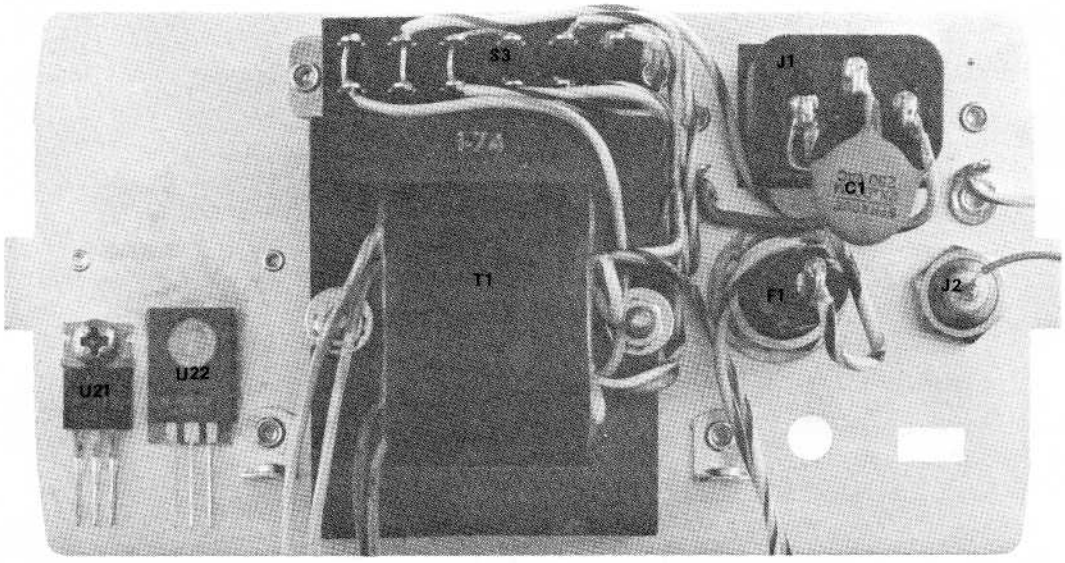
Figure 3-5. Component Locators

A1 (OPTION 001)



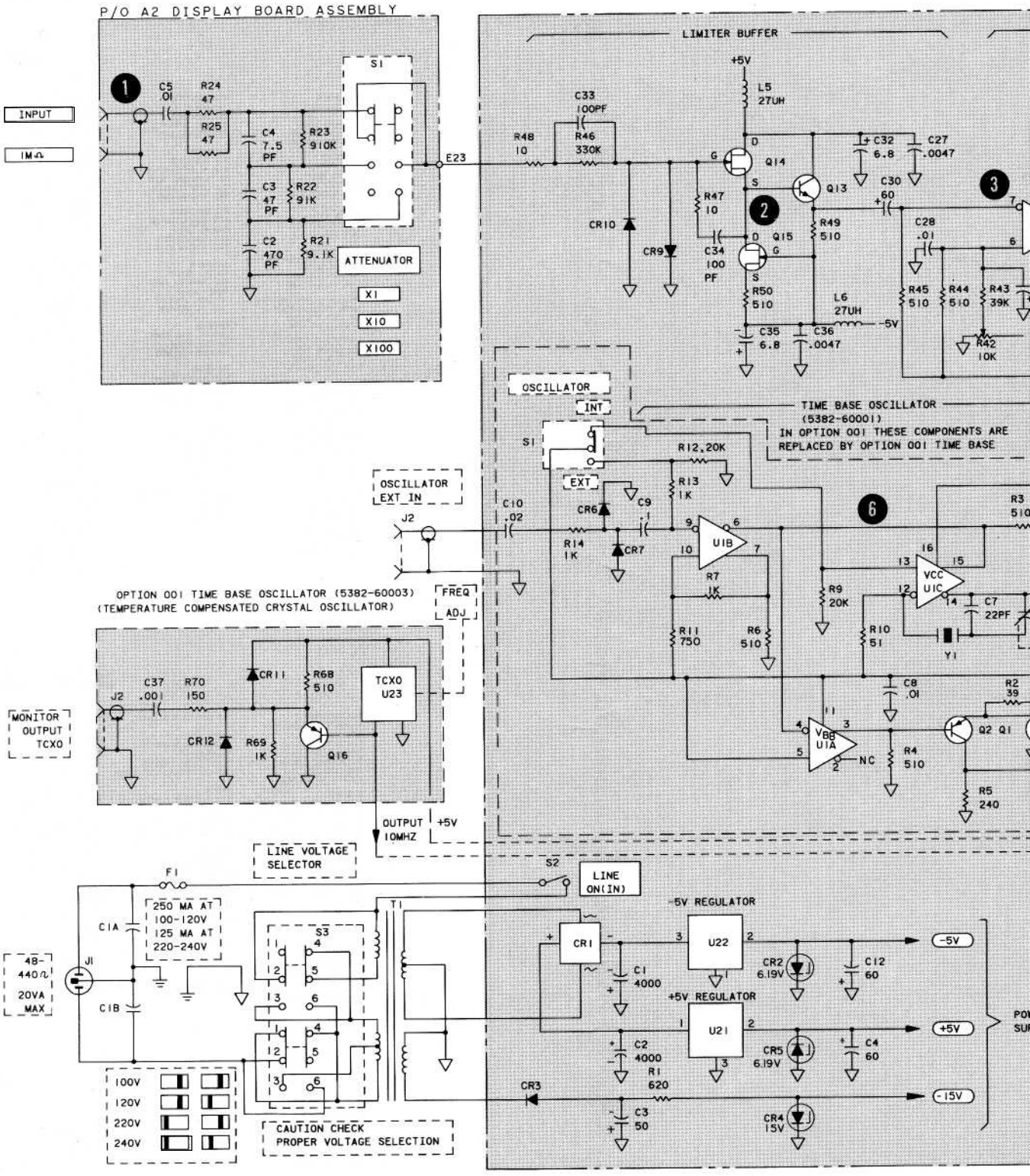
5382-A-6

REAR PANEL

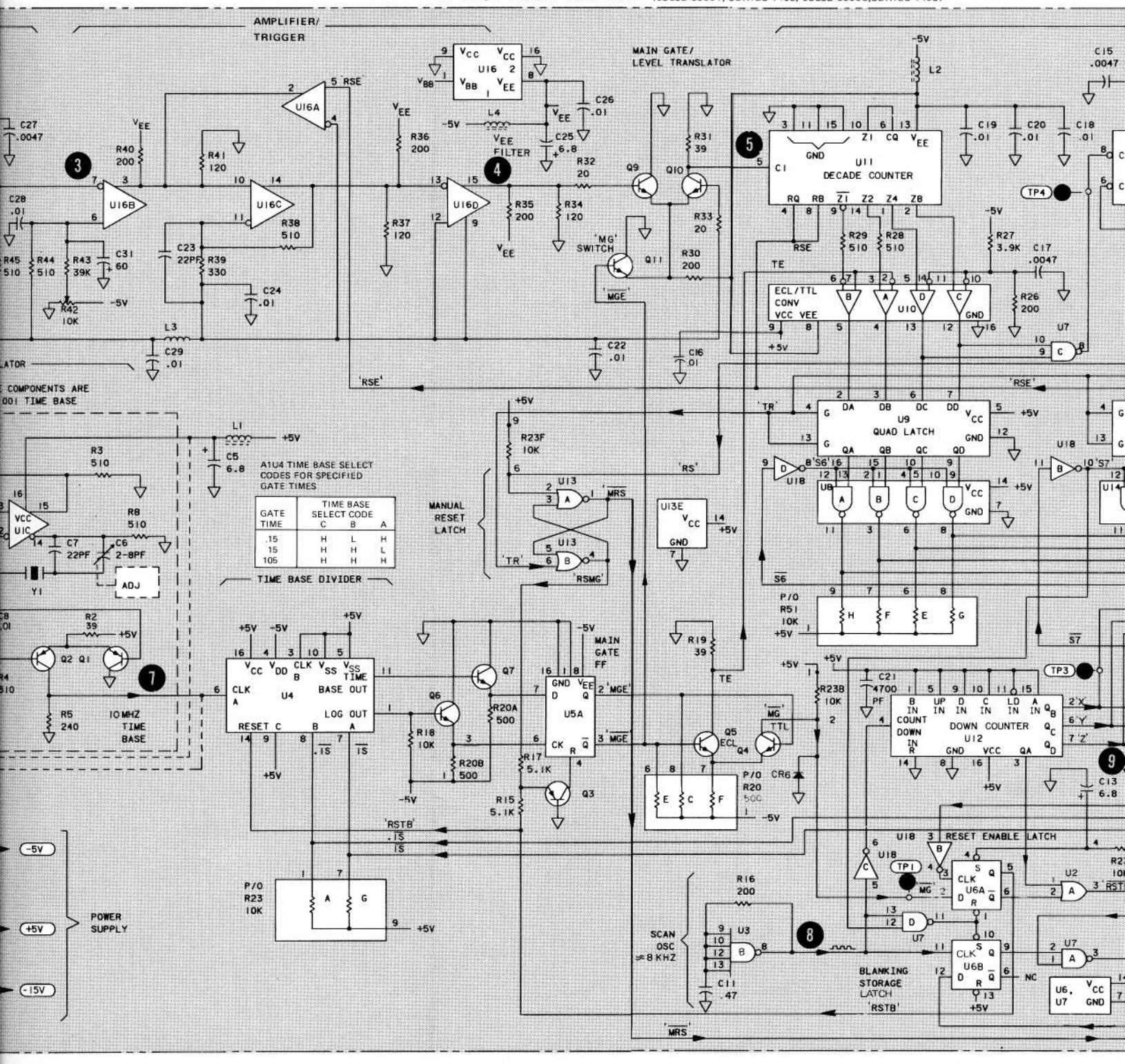


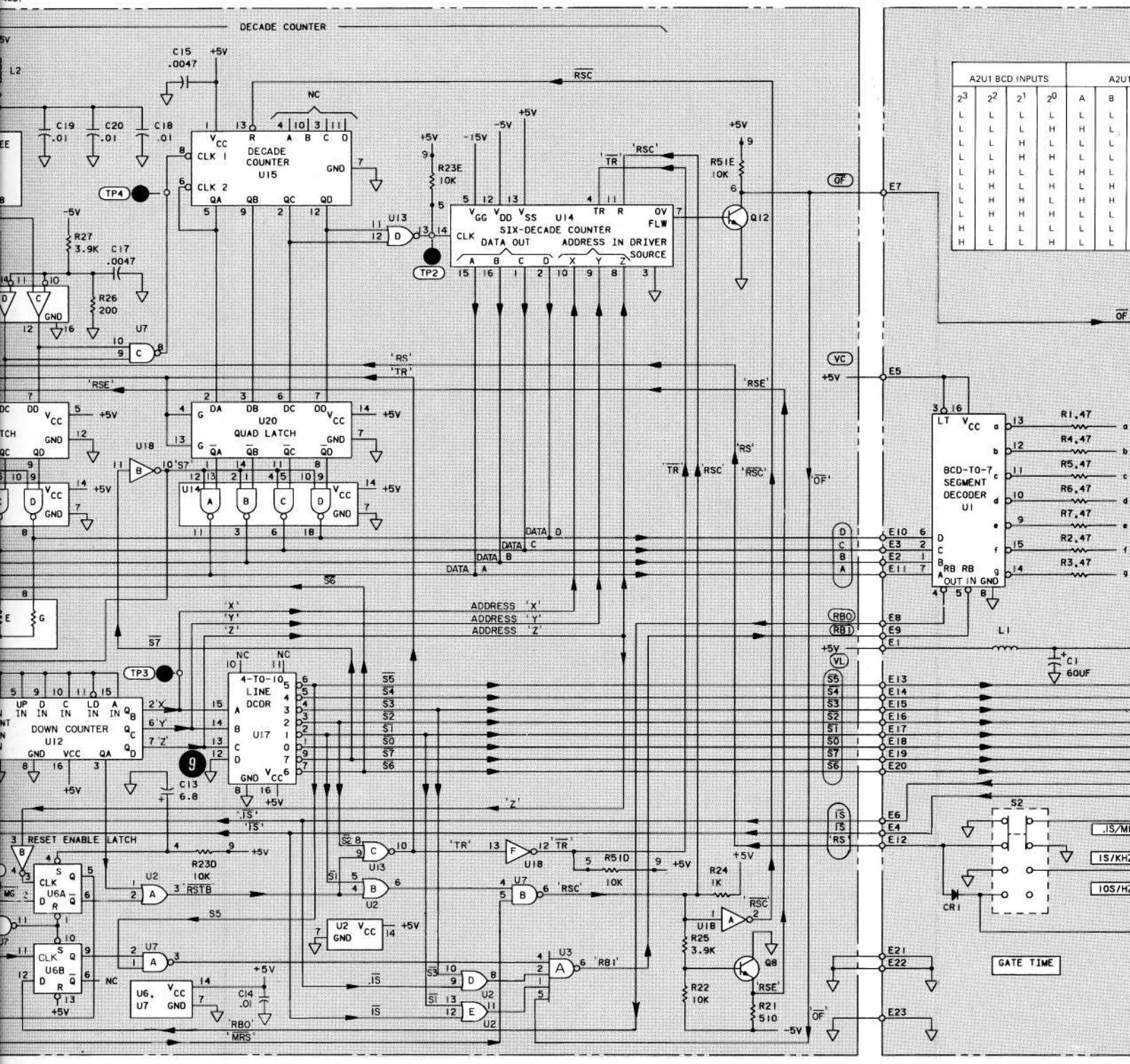
5382-A-4

Figure 3-5. Component Locators (Continued)


P/O A2 DISPLAY BOARD ASSEMBLY
INPUT
1MΩ
S1
C5 .01
R24 47
R25 47
C4 7.5 PF
R23 910K
C3 47 PF
R22 91K
C2 470 PF
R21 9.1K
ATTENUATOR
X1
X10
X100
E23
LIMITER BUFFER
+5V
L5 27UH
C33 100PF
R48 10
R46 330K
Q14
Q13
C32 6.8
C27 .0047
C30 60
R47 10
CR10
CR9
C34 100 PF
Q15
R49 510
R50 510
L6 27UH
-5V
C35 6.8
C36 .0047
C28 .01
R45 510
R44 510
R43 39K
R42 10K
OSCILLATOR
INT
EXT
S1
TIME BASE OSCILLATOR (5382-60001)
IN OPTION 001 THESE COMPONENTS ARE REPLACED BY OPTION 001 TIME BASE
R12, 20K
R13 1K
OSCILLATOR EXT IN
J2
C10 .02
CR6
C9 .1
R14 1K
CR7
U1B
R7 1K
R9 20K
R11 750
R6 510
R10 51
VCC U1C
C7 22PF
Y1
C8 .01
VBB U1A
R4 510
R5 240
Q2 Q1
OPTION 001 TIME BASE OSCILLATOR (5382-60003)
(TEMPERATURE COMPENSATED CRYSTAL OSCILLATOR)
FREQ ADJ
C37 .001
R70 150
CR11
R68 510
TCXO U23
CR12
R69 1K
Q16
MONITOR OUTPUT TCXO
OUTPUT 10MHZ
+5V
LINE VOLTAGE SELECTOR
F1
S2
LINE ON(IN)
250 MA AT 100-120V
125 MA AT 220-240V
C1A
C1B
J1
48-440Hz 20VA MAX
S3
T1
-5V REGULATOR
CR1
U22
C1 4000
CR2 6.19V
C12 60
+5V REGULATOR
U21
C2 4000
CR5 6.19V
C4 60
R1 620
CR3
C3 50
CR4 15V
-15V
100V
120V
220V
240V
CAUTION CHECK PROPER VOLTAGE SELECTION

A1 MAIN BOARD ASSEMBLY (05382-60001, SERIES 1408; 05382-60003,SERIES 1408)

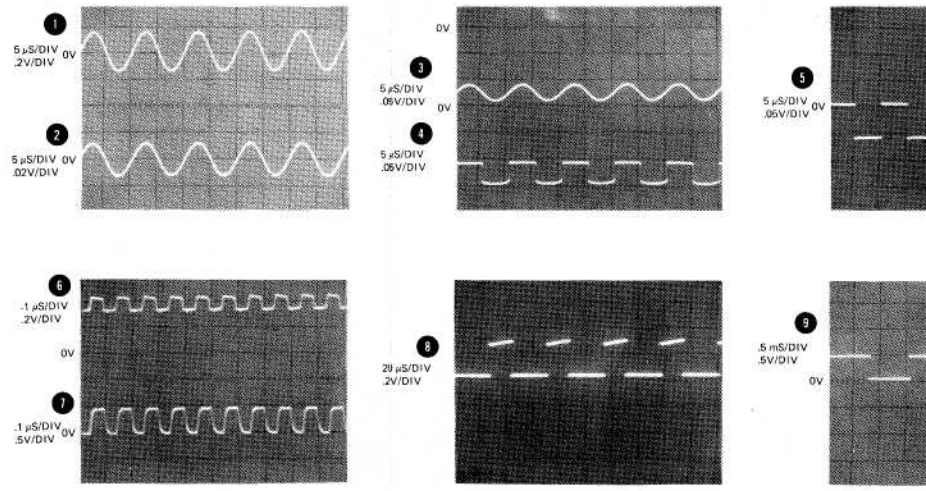


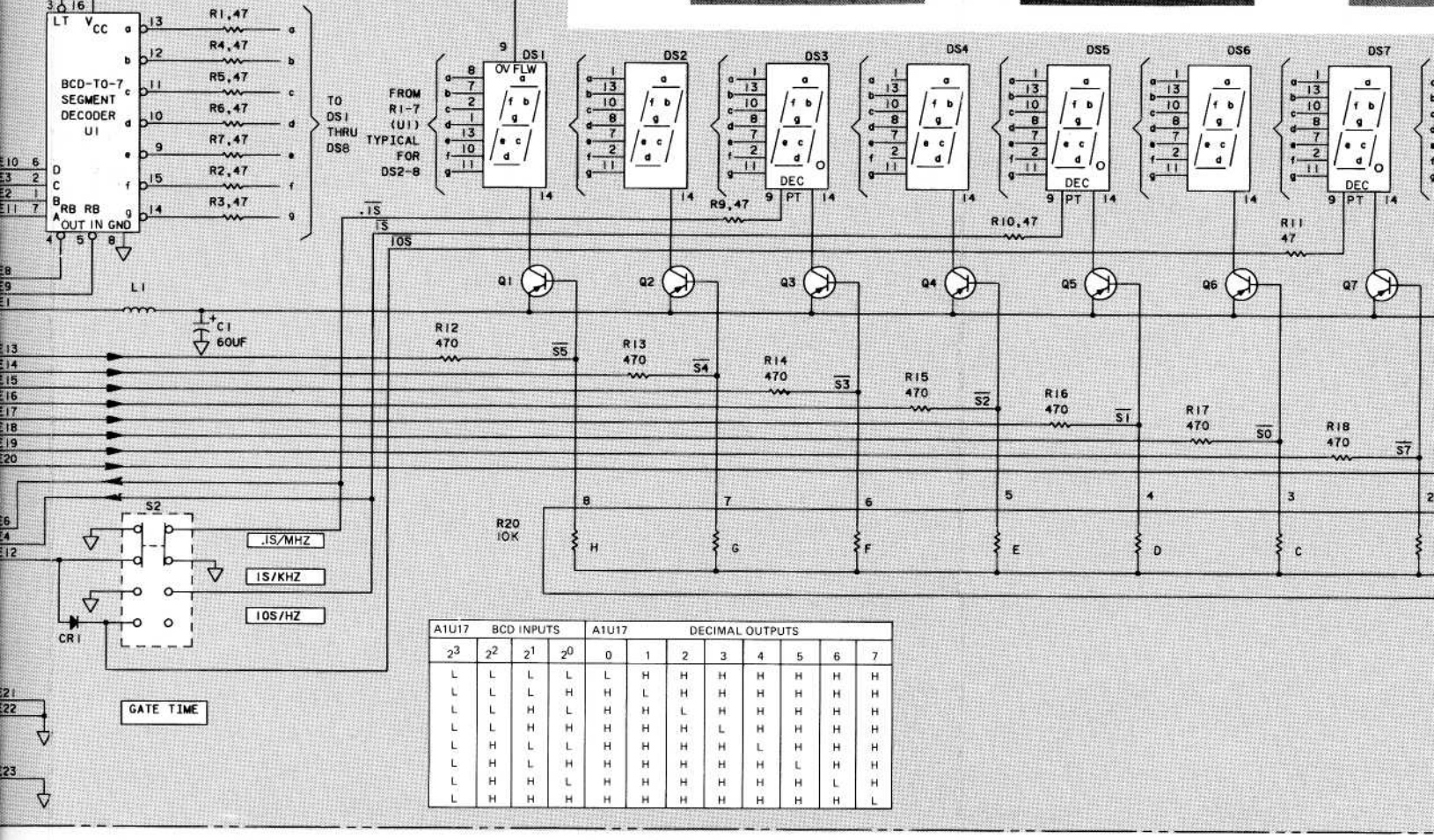

DECADE COUNTER
C15 .0047
+5V
RSC
NC
C19 .01
C20 .01
C18 .01
DECADE COUNTER U15
CLK 1
CLK 2
GND
TP4
-5V
R27 3.9K
C17 .0047
R26 200
U7
R23E 10K
-15V
U13
TP2
SIX-DECADE COUNTER U14
CLK
DATA OUT
ADDRESS IN DRIVER SOURCE
R51E 10K
Q12
OF
E7
A2U1 BCD INPUTS
RS'
TR'
RSE'
VC
E5
QUAD LATCH U20
U18
U14
DATA D
DATA C
DATA B
DATA A
BCD-TO-7 SEGMENT DECODER U1
R1,47
R4,47
R5,47
R6,47
R7,47
R2,47
R3,47
S6
ADDRESS 'X'
ADDRESS 'Y'
ADDRESS 'Z'
RBO
RBI
E8
E9
E1
L1
C1 60UF
S7
TP3
4-TO-10 LINE DCDR U17
UP DOWN COUNTER U12
C13 6.8
S5
S4
S3
S2
S1
S0
E13
E14
E15
E16
E17
E18
E19
E20
IS
RESET ENABLE LATCH
R23D 10K
RSTB
U6A
U6B
R51D 10K
R24 1K
R25 3.9K
R22 10K
R21 510
Q8
CR1
S2
E6
E4
E12
E21
E22
E23
GATE TIME
C14 .01
MRS

P/O A2 DISPLAY BOARD ASSEMBLY (05382-60002, SERIES 1408)

A2U1 BCD INPUTS				A2U1 SEGMENT OUTPUTS							DECIMAL VALUE
2^3	2^2	2^1	2^0	A	B	C	D	E	F	G	
L	L	L	L	L	L	L	L	L	L	H	0
L	L	L	H	H	L	L	H	H	H	H	1
L	L	H	L	L	L	H	L	L	H	L	2
L	L	H	H	L	L	L	L	H	H	L	3
L	H	L	L	H	L	L	L	H	L	L	4
L	H	L	H	L	H	L	L	H	L	L	5
L	H	H	L	H	H	L	L	L	L	L	6
L	H	H	H	L	L	L	H	H	H	H	7
H	L	L	L	L	L	L	L	L	L	L	8
H	L	L	H	L	L	L	H	H	L	L	9

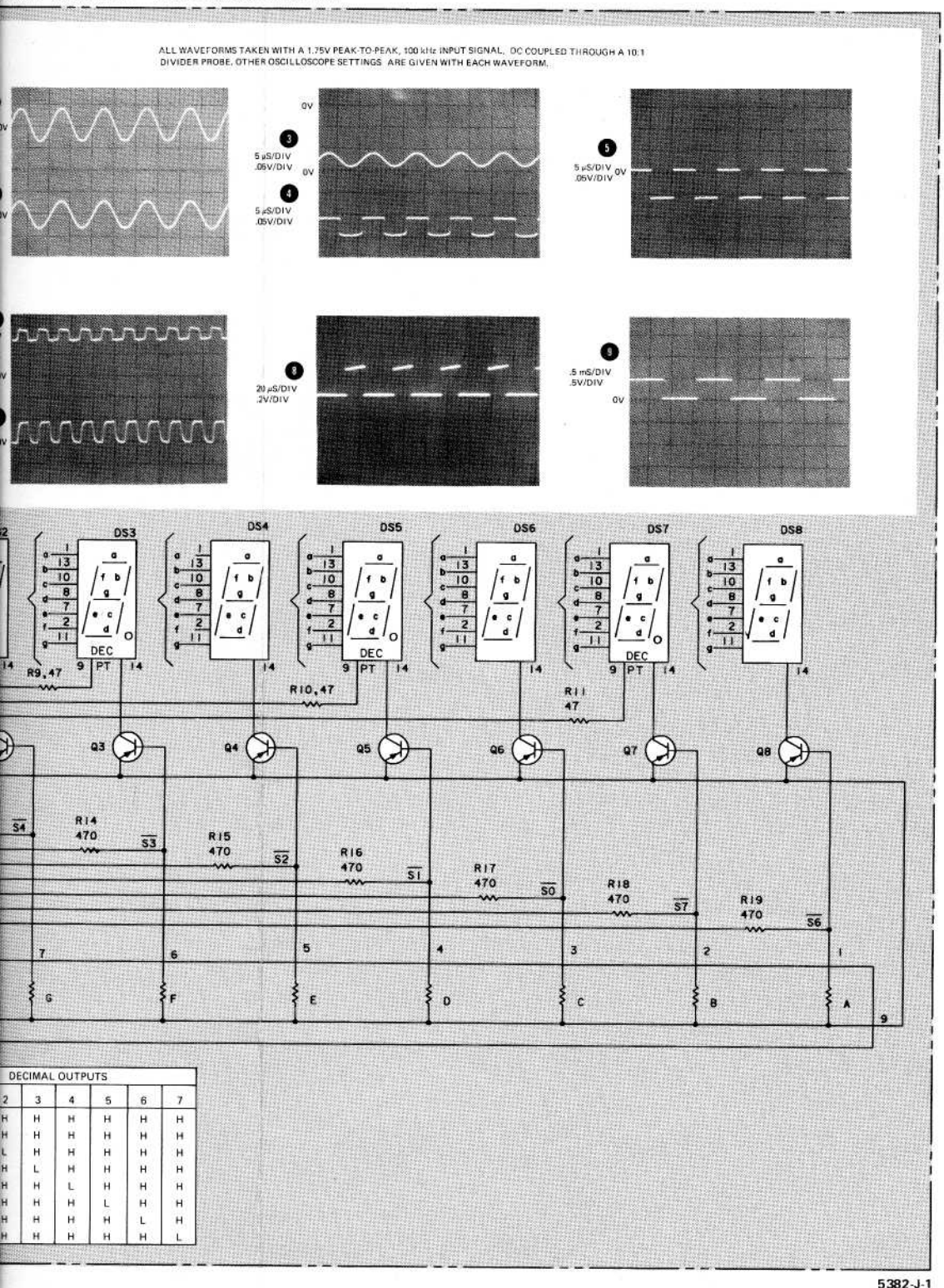
ALL WAVEFORMS TAKEN WITH A 1.75V PEAK-TO-PEAK, 100 kHz INPUT SIGNAL. DC COUPLED THROUGH A 10:1 DIVIDER PROBE. OTHER OSCILLOSCOPE SETTINGS ARE GIVEN WITH EACH WAVEFORM.





A1U17	BCD INPUTS			A1U17	DECIMAL OUTPUTS						
2^3	2^2	2^1	2^0	0	1	2	3	4	5	6	7
L	L	L	L	L	H	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H	H
L	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	H	H	L	H	H	H	H
L	H	L	L	H	H	H	H	L	H	H	H
L	H	L	H	H	H	H	H	H	L	H	H
L	H	H	L	H	H	H	H	H	H	L	H
L	H	H	H	H	H	H	H	H	H	H	L

OARD ASSEMBLY (05382-60002, SERIES 1408)



2	3	4	5	6	7
H	H	H	H	H	H
H	H	H	H	H	H
L	H	H	H	H	H
H	L	H	H	H	H
H	H	L	H	H	H
H	H	H	L	H	H
H	H	H	H	L	H
H	H	H	H	H	L

5382-J-1

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN MICROFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

Figure 3-6. Overall Schematic Diagram

Figure 3-6
OVERALL SCHEMATIC DIAGRAM

(See Page 3-21)

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